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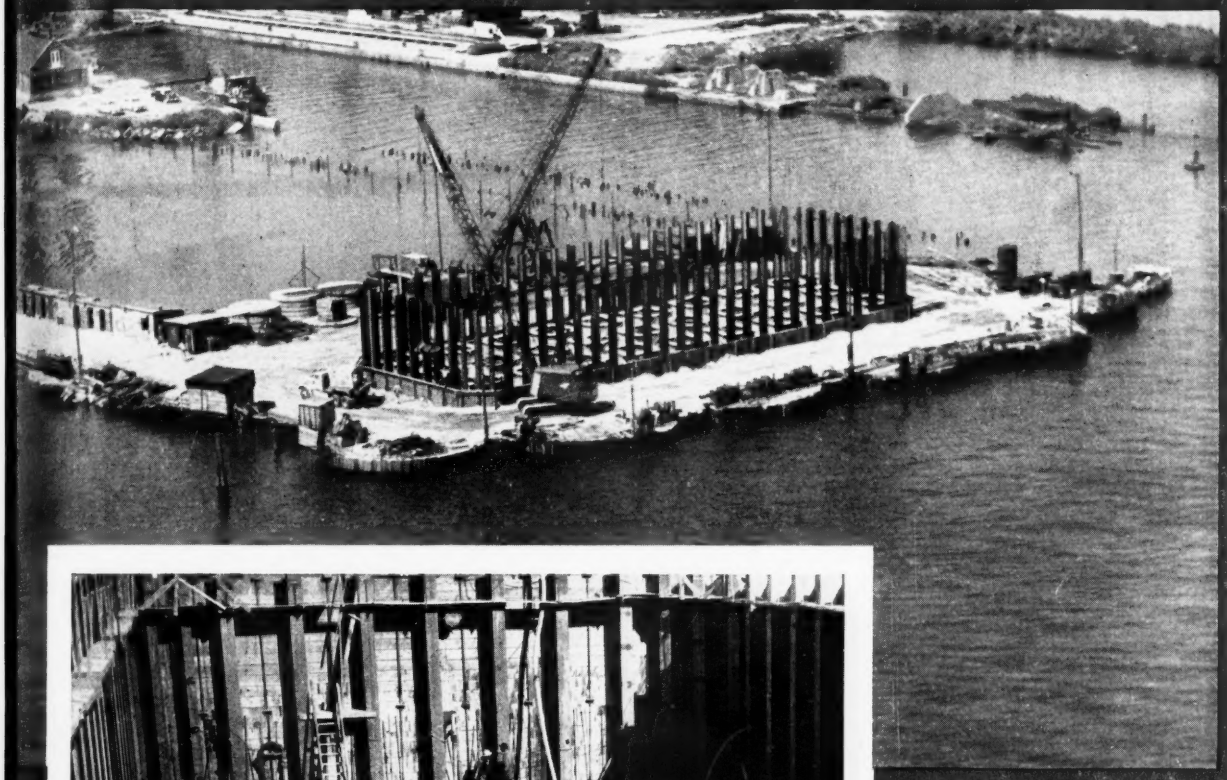
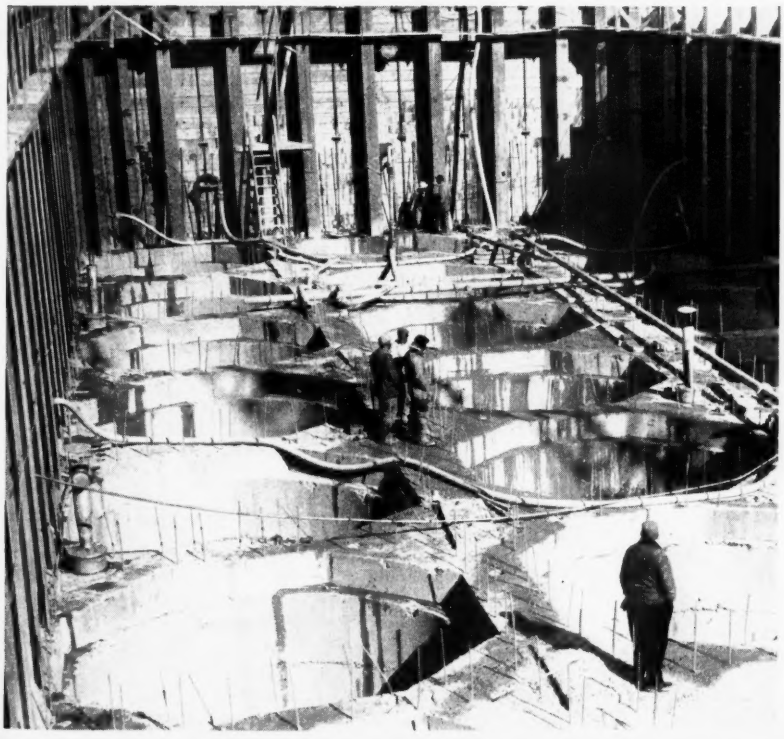
CIVIL ENGINEERING

AUGUST 1955

THE MAGAZINE OF ENGINEERED CONSTRUCTION





SAND ISLANDS

used to sink caissons for piers of Philadelphia - Gloucester Bridge. See article by W. L. Stone, Jr.

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WHEN BUYING A *Hoist* REMEMBER...

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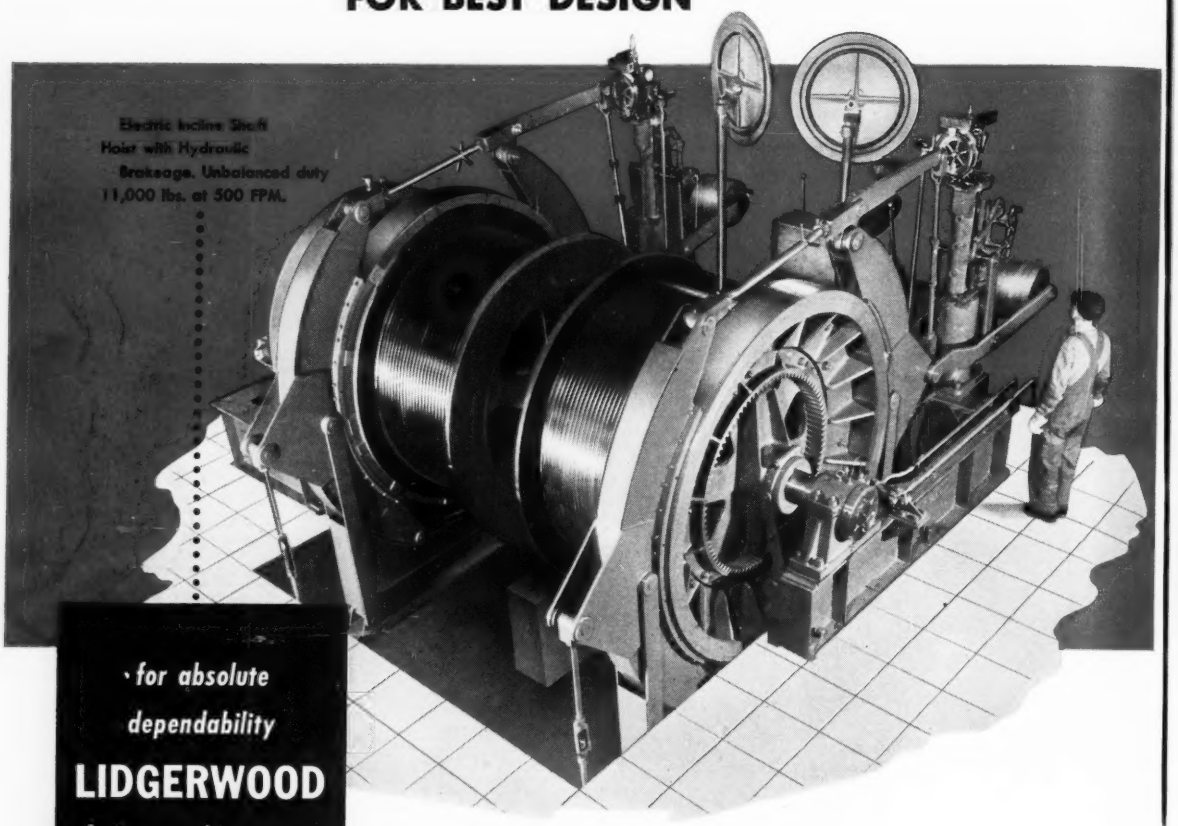

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AUGUST 1955
VOL. 25 • NO. 8

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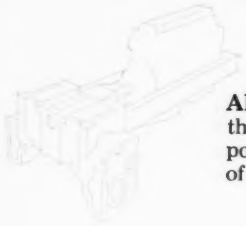

All-Steel Box-A Main Frame that soaks up shock loads, makes possible the service simplicity of unit construction.

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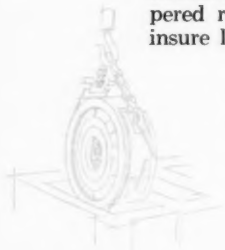

Unit Construction lets you remove engine, master clutch, transmission, steering clutches and final drives without disturbing adjacent parts.

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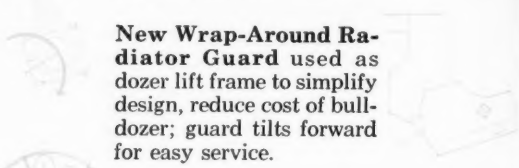

New Wrap-Around Radiator Guard used as dozer lift frame to simplify design, reduce cost of bulldozer; guard tilts forward for easy service.

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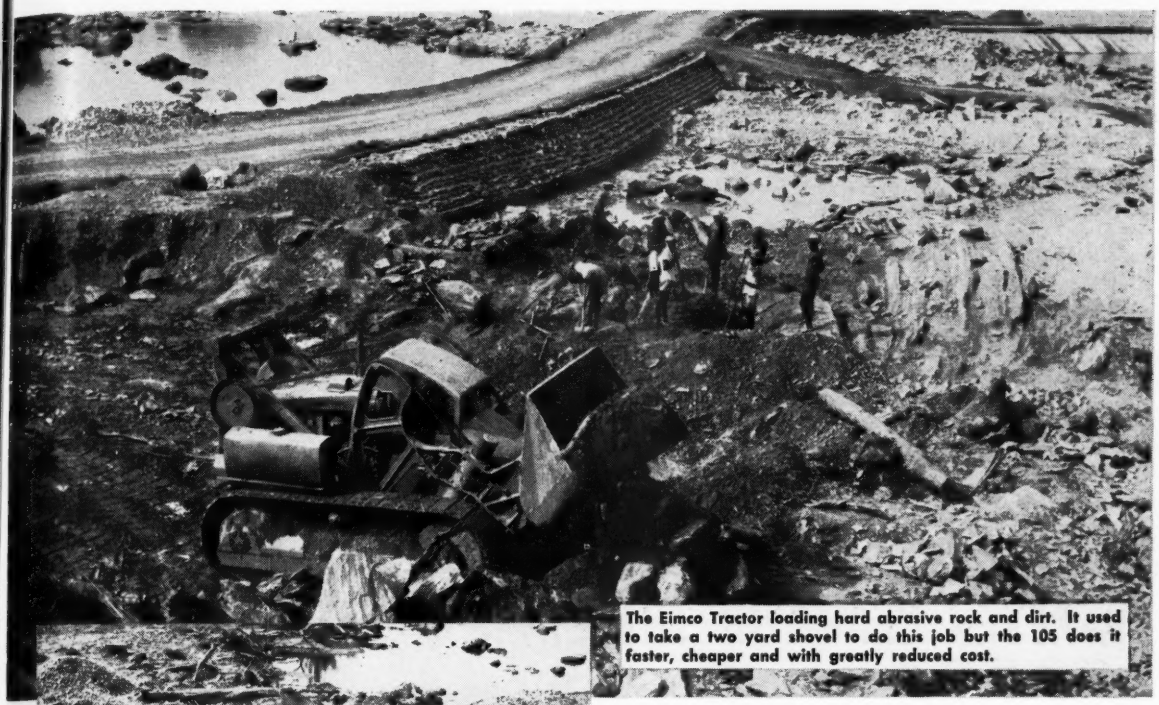

The Eimco Tractor loading hard abrasive rock and dirt. It used to take a two yard shovel to do this job but the 105 does it faster, cheaper and with greatly reduced cost.

The illustrations on this page are all from a river confining levee job in the French Cameroons. Eimcos are selected by contractors all over the world because of their rugged construction and extreme maneuverability.

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Eimco Tractors are the first crawler tractors with power-shift transmissions. Now it is as easy to operate a crawler tractor as driving the latest model automobile. All the work of operating is tremendously simplified — smooth power-controls shift gears and reverse without any operator effort.

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The simplicity of operation permitted by the Eimco power-shift transmission makes it possible for the inexperienced operator to do a creditable job after only a short instruction period.

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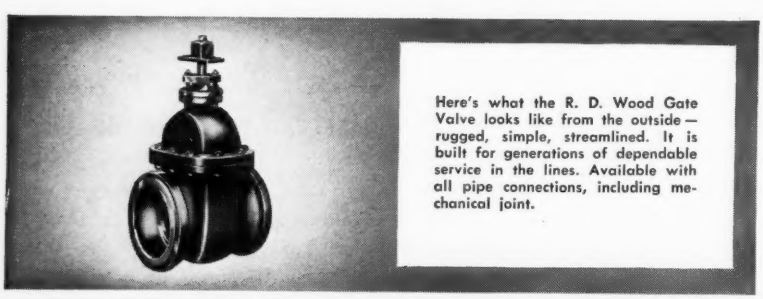
NEWS OF ENGINEERS

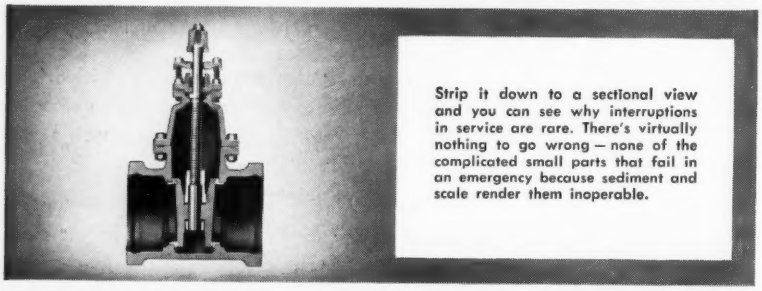
Charles G. Holle, Brigadier General, Corps of Engineers, U.S. Army, and division engineer for the South Atlantic Division, Atlanta, Ga., has been assigned to the Chief of Engineers Office, Washington, D.C. His new assignment is deputy chief of engineers for construction.

Graham P. Willoughby has been appointed district engineer for the New York office of U.S. Steel's American Bridge Division, succeeding **Roland R. Graham** who is retiring after forty-three years of service. Mr. Willoughby has been with American Bridge off and on since 1936. He has been president of the Alabama Section, and is currently ASCE Director for District 10. **Clinton W. Wixom** has been named assistant district engineer in New York City for the Division. Mr. Wixom has been engineer-in-charge of designing and estimating in the New York office since 1948. He went to Venezuela in 1950 in connection with the design of two 28-story office buildings.

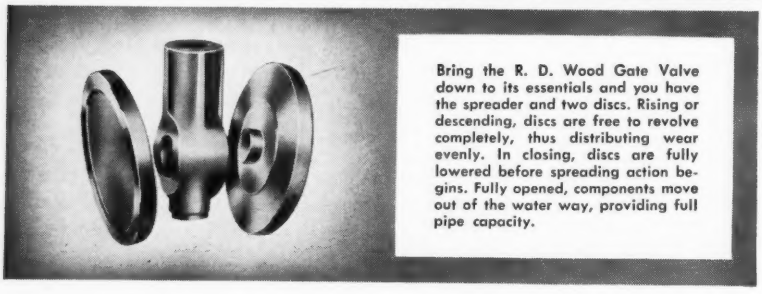
R. D. WOOD GATE VALVES PROVIDE POSITIVE FLOW CONTROL AFTER YEARS IN THE LINES



Here's what the R. D. Wood Gate Valve looks like from the outside — rugged, simple, streamlined. It is built for generations of dependable service in the lines. Available with all pipe connections, including mechanical joint.



Strip it down to a sectional view and you can see why interruptions in service are rare. There's virtually nothing to go wrong — none of the complicated small parts that fail in an emergency because sediment and scale render them inoperable.



Bring the R. D. Wood Gate Valve down to its essentials and you have the spreader and two discs. Rising or descending, discs are free to revolve completely, thus distributing wear evenly. In closing, discs are fully lowered before spreading action begins. Fully opened, components move out of the water way, providing full pipe capacity.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square

Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

William F. Uhl, president of Charles T. Main, Inc., and managing partner of Uhl, Hall and Rich, Boston, Mass., has been named a Fellow of the American Institute of Electrical Engineers. Mr. Uhl was cited "for his contributions to the development and design of hydroelectric plants." A civil and mechanical engineer, he has specialized in the design and construction of hydroelectric plants in his fifty years of engineering.

Norman E. Lant, noted bridge engineer and urban engineer of the Louisiana Department of Highways since 1952, retired July 15 after thirty-two years of service with the Department. A 1913 graduate of Purdue University and post graduate of Trinity College in Dublin, Ireland, Mr. Lant was senior bridge engineer of the Indiana Highway Department before joining the Louisiana Highway Commission as bridge engineer in 1922. He served as chief engineer from 1946 to 1952 and has designed such outstanding bridges as the Mississippi River Bridge at Baton Rouge and the Atchafalaya River bridges at Morgan City and Krotz Springs.

Norman E. Lant

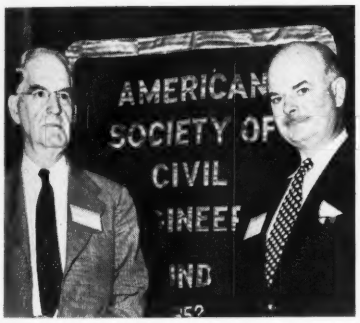
Samuel Young Symns has been made senior partner in Wilbur Watson Associates, Cleveland, Ohio. Also in the firm, **Carl August Carlson,** civil engineer, is junior partner. Others admitted as partners are T. E. Terry, senior partner, and D. W. Englehorn, junior partner.

Richard L. Templin, assistant director of research and chief engineer of tests, Aluminum Company of America, New Kensington, Pa., was honored in June by election to Honorary Membership in the American Society for Testing Materials. Mr. Templin joined the Aluminum Company in 1919 as engineer of tests and has been assistant director of research since 1942. A member of ASTM since 1917, he has served as member of the Executive Committee from 1937 to 1939, vice-president from 1946 to 1948, and president from 1948 to 1949. The Society also gave an Award of Merit to **Edward J. Kilcawley,** head of the Division of Soil Mechanics and Sanitary Engineering at Rensselaer Polytechnic Institute since 1939. Prof. Kilcawley, charter member and chairman of the Committee on Soils for Engineering Purposes, was rewarded for his extensive and valued service to ASTM and particularly for his work on the soils committee.

Walter G. Johnson, for the past ten years engineer of secondary roads for the Kansas State Highway Commission, has been named chief engineer. Mr. Johnson has been associated with the Commission since 1928. He succeeds **Ross C. Keeling** who resigned in October to join Howard, Needles, Tammen & Bergendoff, consulting engineers.

Lincoln B. Grayson has resigned as facilitating services engineer with the Snowy Mountains Hydro-Electric Authority in Cooma, Australia, to join the office engineering staff of Kaiser-Walsh-Perini-Raymond, joint venture contractors on the project. Previously Mr. Grayson worked on hydroelectric construction in Tasmania, Australia.

James H. Griffin, for the past ten years chief engineer of the New York City Board of Transportation, retired this June after forty-two years with the Transit System. During his long tenure he has worked on the extension of the I.R.T. subway division into Brooklyn and on construction of most of the present B.M.T. division and the entire IND division.



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Allison C. Neff, vice-president of Armco Drainage & Metal Products, Inc., Middletown, Ohio, is new president of the National Society of Professional Engineers. Mr. Neff has served as vice-president of the Ohio Highway & Turnpike Association. He is shown with President Glidden at the recent St. Louis Convention. Three ASCE members have been elected NSPE regional vice-presidents: Warner Howe, partner of Gardner & Howe, structural engineers of Memphis, Tenn., is Southeastern Region vice-president; Garvin H. Dyer, manager and chief engineer of the Independence Division of the Missouri Water Company, North Central Region vice-president; and Virgil E. Gunlock, chairman of the Chicago Transit Board, Central Region vice-president.

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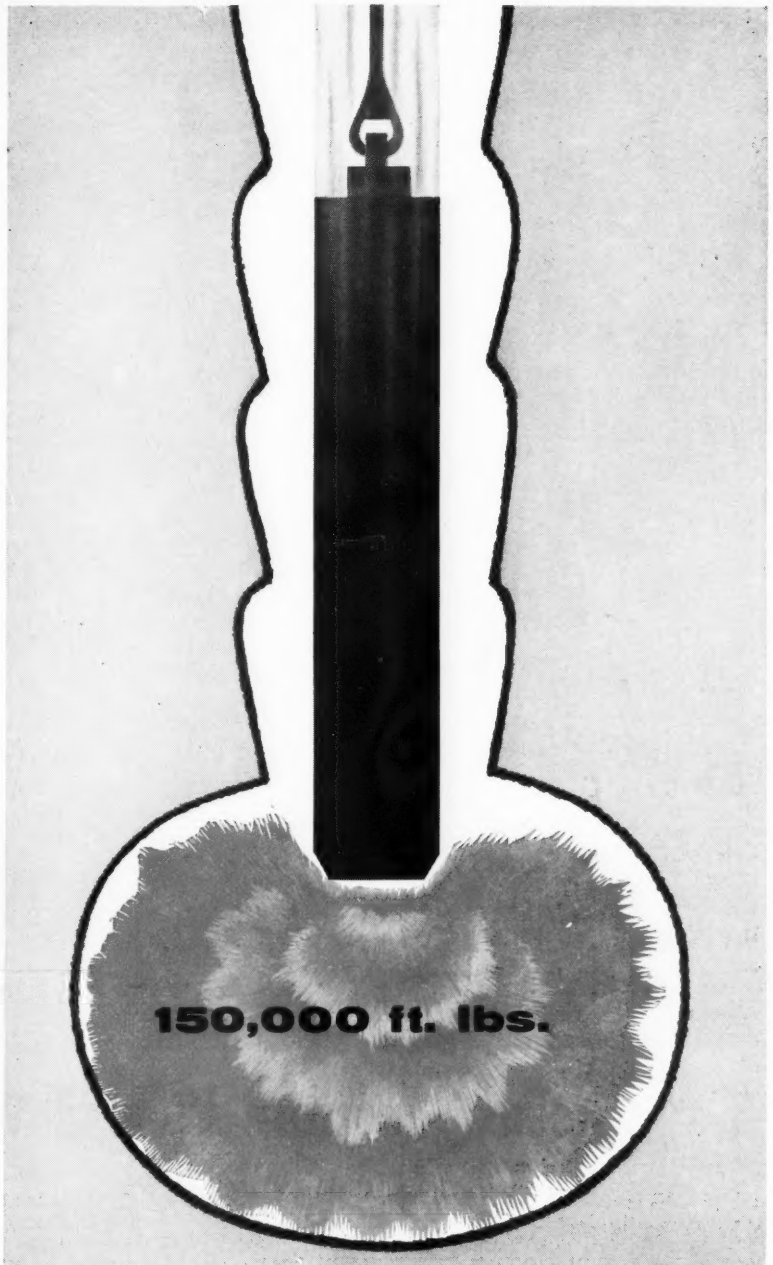

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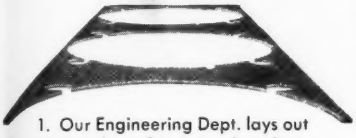

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News of Engineers

(*Continued from page 23*)

Roy H. Christ has left Southwest Steel Products, a subsidiary of Armco Steel, Dallas, Tex., and is now sales manager for the J. E. Weaver Iron Works in the same city.

N. M. Newmark

Nathan M. Newmark, research professor of structural engineering at the University of Illinois, received an honorary degree of Doctor of Science from Rutgers University this June. Dr. Newmark graduated from Rutgers in 1930 and then became associated with the University of Illinois. He has been a member of the Scientific Advisory Board of the Army Air Force since 1945.

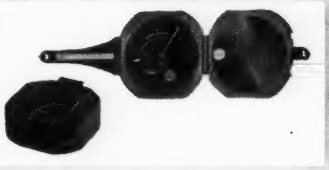
Carl I. Olsen has been appointed resident engineer for Floyd G. Browne and Associates, engineering firm of Marion, Ohio. Mr. Olsen's previous experience included work at the Portsmouth, Ohio, Atomic energy plant with Peter Kiewit, general contractors, and maintenance engineering work for the Veterans Administration in Washington, D.C.

Elwood T. Nettleton, with the Connecticut State Highway Department at New Haven since 1945, most recently as engineer of contracts, has resigned to enter private practice as a construction consultant. In the department he has served as safety engineer and district engineer for district 3 at New Haven.

Frank L. Flood (left), partner in the Boston consulting firm, Metcalf & Eddy, receives his hood signifying an honorary Doctor of Engineering degree from Carl S. Ell, president of Northeastern University, at the June graduation ceremonies. Mr. Flood was cited for his "creative activities as a writer, lecturer and consultant on engineering works and for his leadership in professional societies."

(*Continued on page 28*)

BRUNTON* pocket transit



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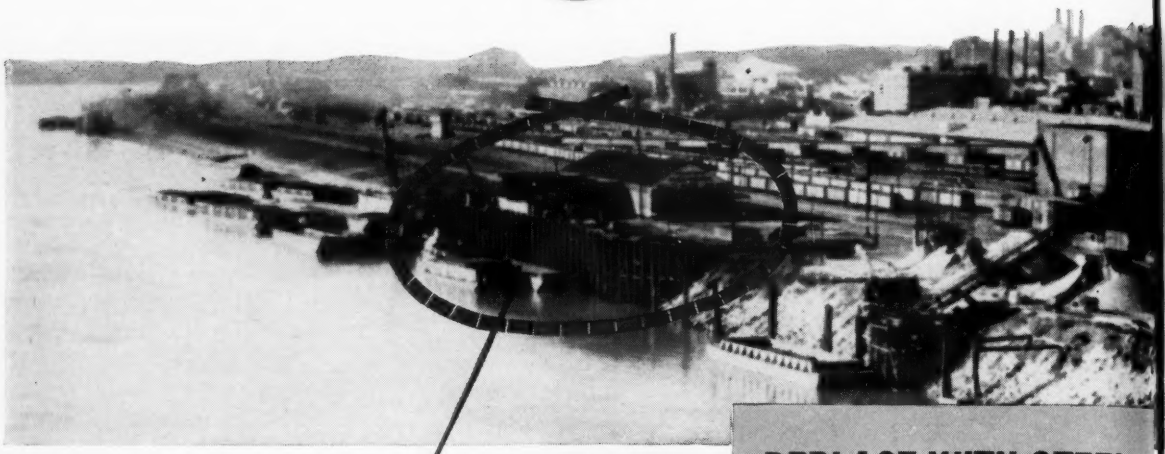
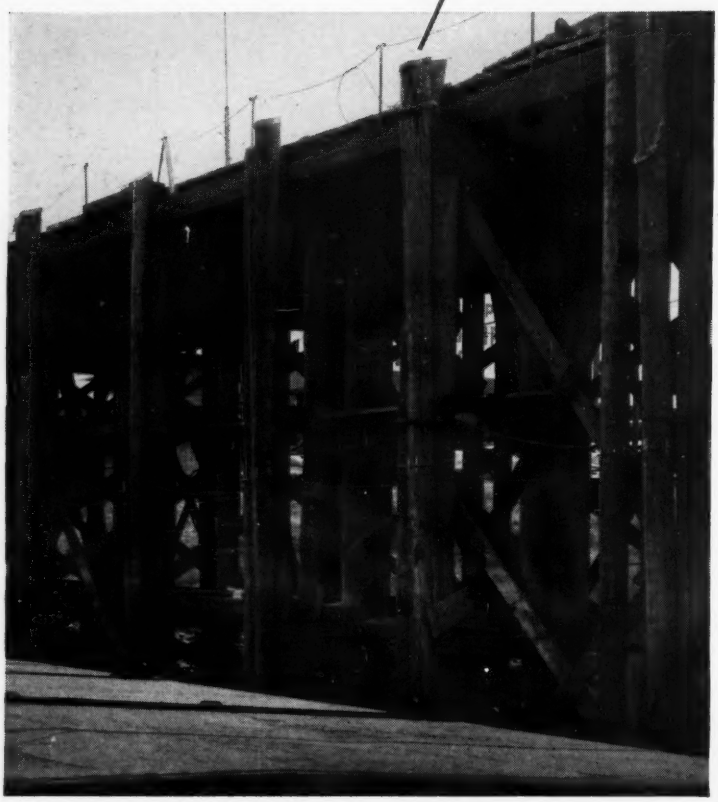




REPLACE WITH STEEL

once and for all!

Time and weather beaten, the old dock above with its wooden piling, at left, cost the owners a pretty penny in maintenance until replaced with long-lasting, *trouble-free* USS Steel H-Beam Bearing Piles, as shown at the right. If you have a similar upkeep problem, why not consider the advisability of modernizing your piers and docks with these more permanent steel piles.

On large jobs and small—under piers, docks, buildings, bridges and viaducts, these strong, easily driven H-Beam Piles have proved their ability to provide a secure means of carrying foundation loads into stable mediums lying at great depth. Their capacity for high unit loads, both vertical and horizontal, permits fewer driving operations for a given load. USS Steel H-Beam Bearing Piles are easy to splice, eliminate jetting, and withstand rough handling.

BELOW: The old wooden floor of the dock was replaced with serviceable USS Multigrip Steel Floor Plates.

USS Steel H-Bearing Piles

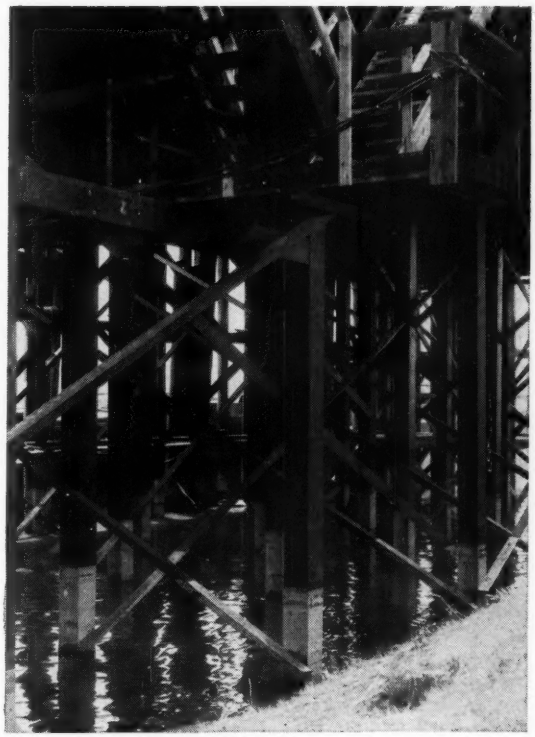
Mississippi Valley Barge Line figures new steel foundation for this important pier will pay for itself in about 20 years!

Time, weather, and the erosive waters of the turbulent Mississippi made maintenance of this important old St. Louis pier a costly proposition. Frequent repairs interfered with the profitable operation of this normally busy, and often crowded, dock.

Finally fed up with such periodic inconveniences, its owners, the Mississippi Valley Barge Line Company, decided to replace the original wooden piles supporting the 195'6" x 40' dock with steel bearing piles. They figured that the permanence of steel would prove more economical than wood when pro-rated over a 20-year period.

The modernization job was done by Massman Construction Company, Kansas City, Missouri, who chose USS Steel H-Bearing Piles for the heavy-duty foundation. One hundred and sixteen tons of CBP-124 (12"—53#) steel H-piling in lengths of 60' and 70' were used to support the rebuilt dock. The new steel piles were driven to refusal at a depth of about 35' into coarse sand and gravel.

The company also replaced the old timber flooring with USS Multigrip Steel Floor Plate. The resulting improvement is a sturdier, longer-lasting dock—one that will more than pay for itself in the practically maintenance-free service it gives.



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USS Steel H-Bearing Piles USS

UNITED STATES STEEL

News of Engineers

(*Continued from page 25*)

George Arthur Sedgwick, until recently structural engineer for W. P. Day, Architect-Engineer of San Francisco, Calif., announces the formation of a partnership with **William H. Ellison.** The new firm, Ellison, Sedgwick and Associates, Consulting Structural Engineers, will be located at 1045 Sansome Street, San Francisco 11, Calif.

Anthony J. Scullen, Sr., retired dean of the School of Engineering and Architecture at the Catholic University of America, and formerly with the District of Columbia Department of Building Inspection, has become an associate in the firm, Edward J. Scullen & Associates, structural engineers of Bethesda, Md.

Francis H. Falkner, Colonel, Corps of Engineers, U.S. Army, and since 1953 resident member of the Board of Engineers for Rivers and Harbors, Washington, D.C., has been assigned to Sixth Army Headquarters in San Francisco. Colonel Falkner has been in the Army for twenty-seven years.

Lewis K. Osborn, structural engineer with Kistner, Wright & Wright, architects and engineers, Los Angeles, Calif., has become an associate member in the firm.

Robert W. Van Houten, president of Newark College of Engineering, received a Doctor of Engineering degree at the June commencement exercises of Stevens Institute of Technology. Mr. Van Houton, a resident of Maplewood, N.J., is a civic leader in New Jersey.

Metullus A. Barnes, Jr., Captain, Corps of Engineers, U.S. Army, was recently assigned to the Waterways Experiment Station, Vicksburg, Miss., for special duty with the Flexible Pavement Branch. Captain Barnes received the Presidential Unit Citation (ROK) and the Air Medal for his service in Korea. Recently he has been at Camp Cambell, Ky., and in Labrador as resident engineer for the Atlantic District on construction of a radar station.

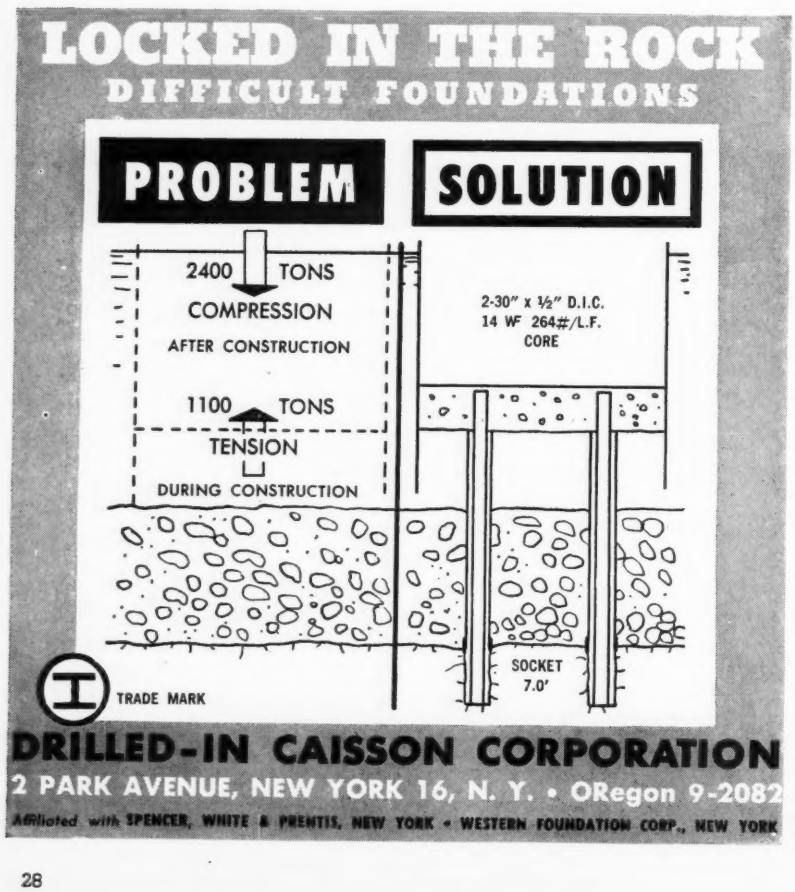
M. A. Barnes

George E. Gyongya, formerly civil engineer with James C. MacKenzie in New York City, has been appointed chief engineer of the industrial division of the Terminal Construction Corporation, Wood-Ridge, N.J. Mr. Gyongya is chief of the appraisal section of the New York field office of the Public Housing Administration.

Frank M. Masters, partner in the consulting firm Modjeski & Masters, Harrisburg, Pa., received an honorary degree of Doctor of Engineering at the eighty-seventh annual graduation exercises at Lehigh University this June. Mr. Masters was praised for his contributions in the field of bridge engineering, his work on American and European projects, and his valuable research on the performance of structural materials.

John Brumbaugh, formerly chief engineer for Samuel Braen & Sons, Hawthorne, N.J., announces the formation of a firm for the practice of civil engineering in New Jersey, New York and Pennsylvania. The firm, named John Brumbaugh & Associates, will have its headquarters at Mahwah, N.J. It will specialize in drainage, soils engineering, pavement design, land surveying, sanitation and sewerage, and industrial, commercial and residential site planning.

Charles W. Yoder, consulting engineer of Milwaukee, Wis., announces the reorganization of his office to include **Ned E. Fischer,** formerly assistant to the engineering firm of Brimeyer, Grellinger & Rose, Milwaukee, as partner. The firm, named Charles W. Yoder—Ned E. Fischer, Associates, is located at 3075 North 35th Street, Milwaukee 10. It will specialize in buildings, foundations, bridges and highways.



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John C. Seeger, Jr., sanitary engineer with the American Well Works, Aurora, Ill., will become assistant professor in the civil engineering department at Illinois Institute of Technology this September. Mr. Seeger had previously taught mechanical and civil engineering at Louisiana Polytechnic Institute.

William E. Willey, formerly assistant deputy state engineer in charge of the Division of Office and Planning of the Arizona Highway Department, has been appointed state highway engineer. Connected with the Department since 1932, Mr. Willey has been responsible to a large extent for the use of the Highway Sufficiency Rating System now widely recognized. Also promoted in the department are **James S. Mills,** from engineer, to assistant deputy state engineer for Office and Planning, and **William S. Johnson,** promoted from assistant engineer of contracts and specifications to engineer in the same department.

Samuel D. Sturgis, Jr., Major General, U.S. Army, and chief of engineers, received a Doctor of Engineering degree from Rose Polytechnic Institute at the June graduation exercises. General Sturgis delivered the Institute's seventy-seventh commencement address on the subject, "Engineering for Humanity."

Wesley W. Horner, senior partner of the St. Louis firm, Horner & Shifrin, received the Gold Achievement Award Medal from the Engineers' Club of St. Louis at the club's eighty-seventh annual dinner in May. Mr. Horner was hailed as a pioneer in airfield engineering, in expressways and water supply problems. He was President of ASCE in 1946, and is also past-president of the American Public Works Association.

Robert J. Jackson, Jr., Lieutenant Colonel, Corps of Engineers, has been named post engineer at Walter Reed Army Medical Center. The past two years he was an engineer adviser to the Thai Army with the Joint U.S. Military Advisory Group. Before entering the service in 1940, Colonel Jackson served as tunnel construction engineer with the Port of New York Authority.

S. Newbold Van Trump, founder and president of the Wilmington Suburban Water Co., Claymont, Del., retired on June 30. Prior to founding the company in 1932, Mr. Van Trump worked for the Wilmington Gas Company and for many years was superintendent and then chief engineer for the Wilmington Water Department.

Gerald C. Ward was recently awarded the degree of Civil Engineer by the University of Wisconsin—the highest engineering degree granted by that school. Mr. Ward retired as a colonel from the regular U.S. Air Force in January to become editor of *Better Roads,* highway magazine, with offices in Chicago.

Wilfred M. Hall, vice-president and member of the board of directors of Chas. T. Main, Inc., and a partner in Uhl, Hall & Rich, both of Boston, received an honorary Doctor of Engineering degree at the 99th commencement exercises of Tufts University on June 12. He was cited for demonstrating "the truly constructive nature of engineering as a profession" and for his "contributions to the forward progress of mankind." Mr. Hall is at present occupied with a large hydroelectric project under construction in Turkey and the St. Lawrence Power Project.

© duette

W. M. Hall

J. W. Hale of Wittville, Va., won the class of 1941 award in civil engineering and **J. A. Openshaw** of South Hampton, Mass., received the Meyer Award in Sanitary Engineering at Virginia Military Institute graduation exercises in Lexington, Va., in early June. The class of 1941 award is given to the junior with the highest grades in the civil engineering department and the Meyer Award goes to the graduate with top grades in sanitary engineering courses in the civil engineering department.

Hamilton Gray, since 1945 professor of civil engineering at the University of Maine, has been appointed professor and chairman of the civil engineering department at Ohio State University. He will assume his new duties at Ohio State in October. Professor Gray was on the faculty of New York University from 1940 to 1945 and has been active as a consultant since 1940.

Hamilton Gray

Harold G. Mason and **John A. Bishop,** on the staff of the U.S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif., received the C. A. Hogentogler Award of the American Society for Testing Materials at its fifty-eighth annual meeting in June. The award, established in 1954 by the Committee on Soils for Engineering Purposes in honor of its first chairman, was given in recognition of their paper entitled, "Piles Subjected to Lateral Thrust."

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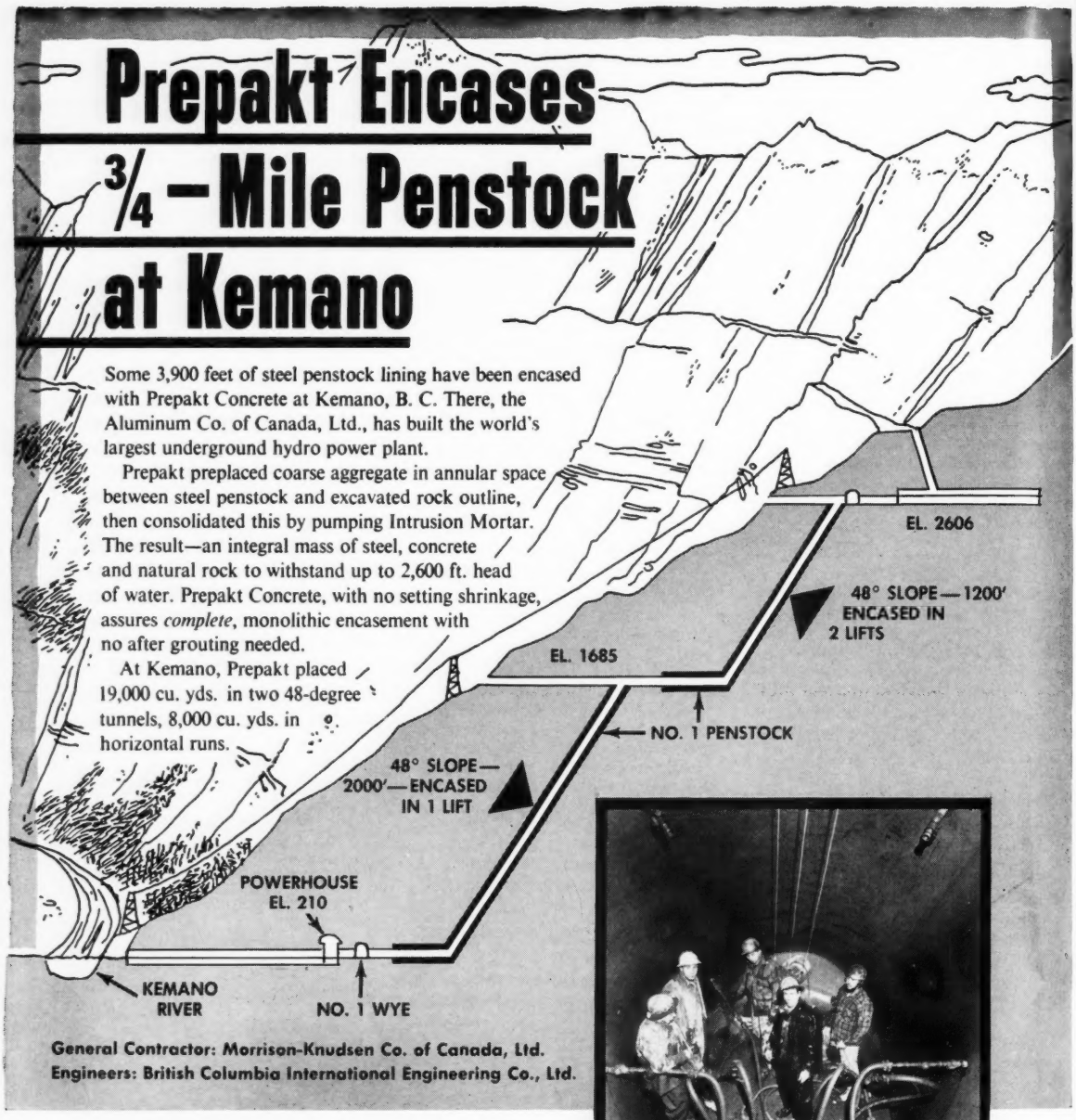
Prepakt Encases ¾-Mile Penstock at Kemano

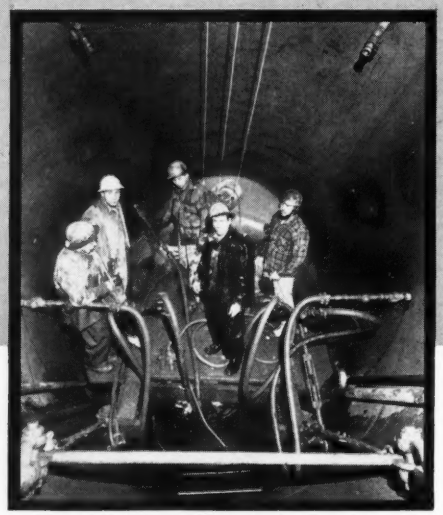
Some 3,900 feet of steel penstock lining have been encased with Prepakt Concrete at Kemano, B. C. There, the Aluminum Co. of Canada, Ltd., has built the world's largest underground hydro power plant.

Prepakt preplaced coarse aggregate in annular space between steel penstock and excavated rock outline, then consolidated this by pumping Intrusion Mortar. The result—an integral mass of steel, concrete and natural rock to withstand up to 2,600 ft. head of water. Prepakt Concrete, with no setting shrinkage, assures *complete*, monolithic encasement with no after grouting needed.

At Kemano, Prepakt placed 19,000 cu. yds. in two 48-degree tunnels, 8,000 cu. yds. in horizontal runs.



General Contractor: Morrison-Knudsen Co. of Canada, Ltd.
Engineers: British Columbia International Engineering Co., Ltd.



Crew inside 11-foot diameter Kemano penstock pumps intrusion Mortar through steel lining to consolidate aggregate preplaced by gravity.

• • •

Lower 2,000-foot angle section was encased in one continuous lift—21 working days! Simultaneous aggregate placement and pumping of mortar was used in around-the-clock work to encase tunnel at average rate of 24 cu. yds. per hour. Upper sloping section was encased in two lifts of 400 and 800 feet.

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do you know that

The shortage of engineers is here to stay? So warns S. C. Hollister, M. ASCE, dean of engineering at Cornell University, in an article in the July issue of *Mechanical Engineering*. The shortage is here to stay, he maintains, "if two conditions now in vogue are continued, namely, the present pattern of utilization of engineers, and the pattern of preparation of the engineers." Dean Hollister calls for more cultural courses in engineering curricula.

The Northwest has four new dams? They are at Lucky Peak and Albeni Falls, Idaho, and Lookout Point and Dexter, Oregon. A fifth and much larger project—Chief Joseph Dam in Washington—will be ready in September. Together they will cost $309,000,000 and add 433,000 kw of generating capacity to the Northwest electric power pool. Built by the Corps of Engineers, the new dams were appropriately dedicated during the Corps' 180th anniversary in June.

Chicago is to have a huge prefabricated convention hall without posts or pillars? The $17,000,000 steel structure—the world's largest clear-span building and the largest prefabricated building ever erected—will be 1,000 ft long and 600 ft wide and have a permanent seating capacity of 25,000. Jay J. Seaver Engineers, of Chicago, are the technical consultants, and the Wonder Building Corporation of America will supply the prefabricated steel sections.

Civil Engineers are commanding higher salaries? The 1955 Report of the ASCE Committee on Salaries—summarized on page 50—reveals that there has been a continuing increase in salaries for all the professional grades since the 1953 Report was issued, and compensation in the higher classifications appears to have increased more, proportionately, than entrance salaries for Grade I. The full report is available as Proceedings Paper No. 761.

According to the Commission on Intergovernmental Relations, the fundamental objective of our system of government should be to keep state and local responsibilities at a maximum? The Commission's report, available at the Government Printing Office, Washington 25, D.C., for $1.25, points a way to strengthen local government and to stop the increasing centralization of government.

Closure has been completed on the fourth of six mainstem dams on the Missouri River? The last 600 ft of Gavins Point Dam, smallest (700,000 cu yd) and farthest downstream of the structures being built under the Pick-Sloan Plan, was closed by dragline and a fleet of dump trucks on August 4. The structure will have a reservoir capacity of 540,000 acre-ft and act as regulator for the mammoth upstream system.

A translucent plastic building material called "pneumatic brick" is being hailed as a long-sought goal in architecture? Triangular in shape and light in weight, the new "bricks" can easily be deflated and carried in a box when not in use. The developers—Prof. Ambrose C. Richardson, of the University of Illinois Architecture Department, and Maj. George W. McCauley, of the U.S. Air Force—suggest using the material to form igloo-like emergency shelters, large greenhouses, protective shields for drive-in theaters and ball parks.

Turnpike travel is increasingly popular? New traffic records were established on the Pennsylvania Turnpike over the Fourth of July weekend, the Turnpike Commission announces. A total of 295,222 vehicles—a daily average of 73,805—used the 360-mile superhighway over the four-day holiday period, producing the biggest traffic flow in the 15-year history of the turnpike.

The search for uranium tops that for all minerals but petroleum? The number of geologists employed by the U.S. Government and industry in prospecting for the precious metal exceeds the number engaged in the study of all other minerals together, with the exception of oil, according to a recent report released by the U.S. Geological Survey and entitled "Search for Uranium in the United States." The 64-page pamphlet—available from the Superintendent of Documents, Washington, at 25 cents—assembles much valuable information on uranium prospecting.

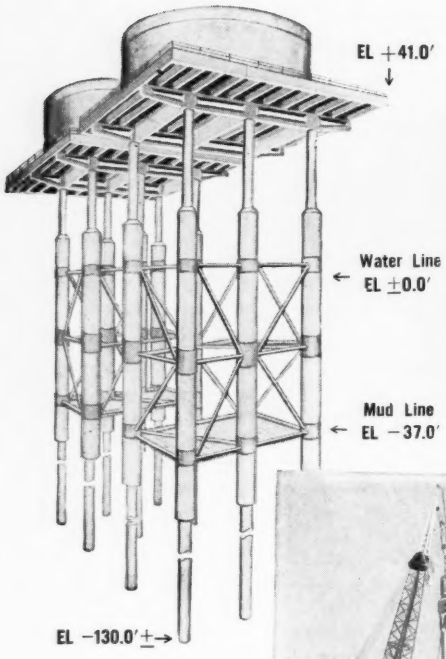
The AEC has approved a regulation permitting civilian use of restricted data? Under a new "access permit" program, confidential restricted data of a non-military nature may be obtained by any person who can show a potential use for the information in his business or profession. The Atomic Energy Commission, Washington, D.C., will give you the details.

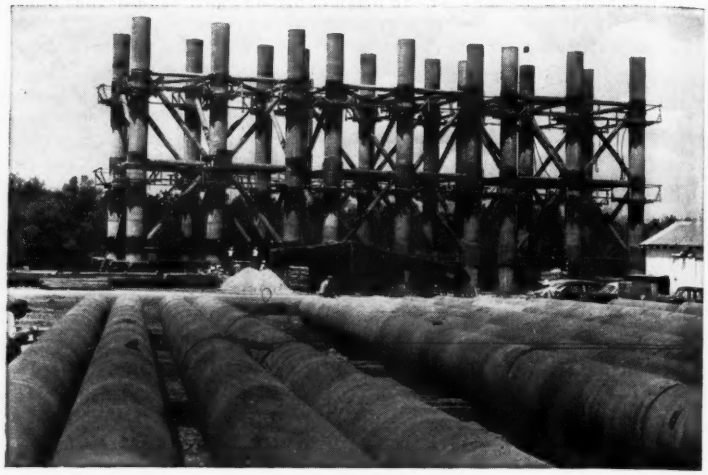
The first atomic-generated electricity is now being sold by a private utility? On July 18, AEC Chairman Lewis L. Strauss threw the switch sending 10,000 kw of excess power from the experimental reactor housed in the steel sphere at West Milton, N.Y., into the lines of the Niagara-Mohawk Power Corp. The reactor was built by General Electric for the AEC. It is a prototype of the reactor in the atomic submarine *Sea Wolf*, launched at Groton, Mass., on July 21.

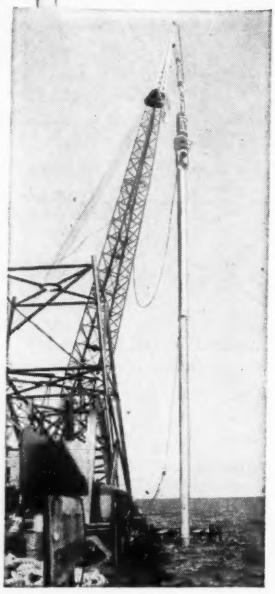
Chicago is proceeding with plans for the fluoridation of its water supply? Mayor Daley gave the green light to the project after Governor Stratton vetoed legislation aimed at forcing a referendum.

Pioneering IN PILING PROGRESS

192-FT.-LONG PRECAST, PRESTRESSED CYLINDER PILE AND PRESTRESSED JACKET ASSEMBLY HIGHLIGHT TANK PLATFORM CONSTRUCTION IN GULF OF MEXICO







Owner: **MAGNOLIA PETROLEUM COMPANY**
Tank Battery Platform, 35 mi. offshore in Gulf of Mexico

Entire Platform Structure Designed by **RAYMOND CONCRETE PILE COMPANY,** New York

Components fabricated by **GULF PRESTRESSED CONCRETE PRODUCTS,** Morgan City, La.

General Contractor: **J. RAY MC DERMOTT, INC.,** Harvey, La.

● Few construction principles have presented a broader opportunity for engineers and constructors than has prestressed concrete. Example of pioneering in this field is Raymond Concrete Pile Company's prestressed hollow cylinder pile, used in lengths up to 192 ft., in a tank battery platform for Magnolia Petroleum Company, 35 miles offshore in the Gulf of Mexico.

Photo, at left, shows 36-in.-diameter cylinder pile, 192 ft. long, standing unsupported 172 ft. above mud, in which it had penetrated 20 ft. under its own weight.

Equally interesting is the precast, prestressed concrete assembly which serves as bracing jacket. The jacket structure, shown above, consists of 54-in. prestressed hollow cylinder piles, braced with concrete-coated pipe. Assembled on barges, the jacket assemblies, each weighing 230 tons, were floated to location, where lift was made and the barge moved out from under.

The prestressed 36-in. cylinder piles were also barged to the site, lifted by crane, lowered through the jacket piles, and driven to required resistance. Finally, prestressed deck slabs were placed in position, ready for installation of two 5,000-barrel tanks.

These piles are reinforced in the conventional manner, then centrifugally cast by spinning. Cylinders are spun in 16-ft. lengths, fitted together, and prestressed by post-tensioning cables run through horizontal openings left in the cylinder walls.

Special methods of joining the cylinders, post-tensioning the steel, and grouting the wire cables produce a homogeneous product of unusual strength and durability.

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CHICAGO PARKING GARAGE features cable barrier

C. A. METZ, M. ASCE, Partner, Shaw Metz & Dolio, Architects and Engineers, Chicago, Ill.

Chicago's 50-million-dollar program for the construction of municipally owned parking facilities has resulted in the recent opening of a number of parking units. One of them, No. 1 in Fig. 1, will be described here. But first it is of interest to review the city's overall program for parking and traffic relief.

By the end of 1955, or early 1956, ten garages will have been completed and new, spacious parking lots developed in various sections of the city to help relieve the on-street parking problem and consequent traffic congestion, particularly in the downtown area. These ten parking facilities, locations for nine of which are shown in Fig. 1, will have a combined capacity of 6,900 automobiles. This is in addition to the 2,359 spaces provided by the Chicago Park District garage under Grant Park and Michigan Avenue. Together, the new parking spaces provided by the city and the Park District programs will total 9,259 car positions. These structures represent an important phase of Chicago's program for traffic relief, which includes one-way streets, effec-

Tensioned steel cables, running from second floor to top of building, take place of walls in Chicago's Parking Facility No. 1. Final step in installation is tensioning of each cable by turnbuckle at top of building. Structure was built at cost of about $\$1\frac{1}{2}$ million, or $2,104 per stall for the 717 stalls.

FIG. 1. Chicago's 50-million-dollar program for traffic relief includes construction of ten parking garages at numbered locations shown on map. (No. 7 is located outside of area shown.) Parking Facility No. 1, here described, is strategically located on Wacker Drive, near north end of Loop.

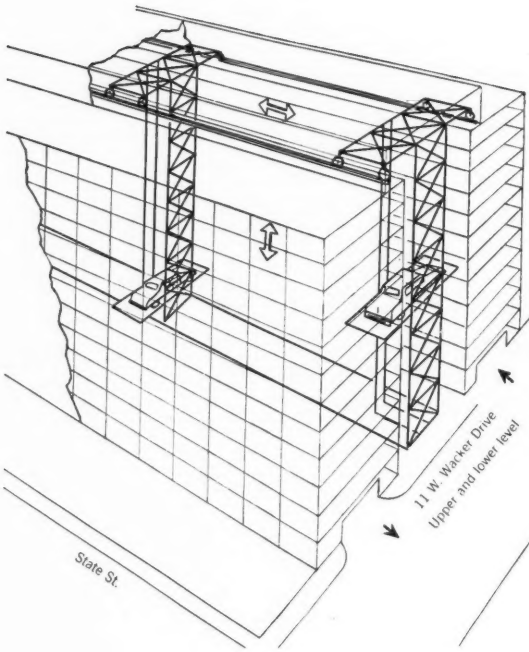


FIG. 2. Chicago parking garage is designed around central hoistway in which mechanical lift equipment operates. Five combined elevator and crane units (one for each bay) are suspended from bridge-type crane to obtain simultaneous vertical and transverse movement. Thus a car can be delivered to any parking pocket in about one minute.

tive traffic control, parking meters, subways and superhighways.

The first step in bringing this program to successful completion was the passage, by Chicago's City Council on January 10, 1952, of an ordinance authorizing the city to negotiate with an investment banking group for financing of the proposed facilities. In accordance with the resulting agreement, the banking group employed DeLeuw Cather & Company, Engineers, to prepare a report on parking facilities for the Central Business District, the North Michigan Avenue area, and 63rd and Halsted, which was filed with the City Council on July 2, 1952. On September 18, the City Council passed an ordinance, based on this report, authorizing issuance of up to $50,000,000 in Chicago Parking Facility Revenue Bonds. On January 26, 1953, the City Council passed an ordinance directing the city to acquire sites for parking facilities and approved agreements with ten architectural firms for the design of ten parking structures. These parking garages range in height from two to fourteen levels; some have mechanical lifting equipment, others are of the ramp type.

The site chosen for Municipal Parking Facility No. 1, on the south side of Wacker Drive between State and Dearborn Streets, is readily accessible to two-way traffic on both upper and lower levels of Wacker Drive, and thence directly connects with Chicago's great new system of superhighways (Fig. 1). It is conveniently located with respect to the north end of the Loop area, and is served by shuttle bus which operates throughout the remainder of the downtown area. Among the important office and retail structures it serves are the La Salle-Wacker Building, Pure Oil Building, London Guarantee Building, Marshall Field and Company, and many stores. The garage has a capacity of 717 cars and is 14 levels in height, 12 of which are used for parking and two for drive-in access from street to car hoists.

Reinforced concrete construction was selected as ideally suited to the simple cantilevered parking decks which form an integral part of the architectural treatment. This design is further enhanced by the safety barrier, which consists of a series of stainless steel cables spaced 8 in. on centers, extending in one piece from the second floor to the roof, instead of parapet wall construction. The foundations are belled caissons resting on hardpan. The floor and roof framing consists of concrete beams and pan-and-joist floors. Flat-slab floors were used over the lower and upper levels of Wacker Drive.

The parking decks are on each side of a great well 21 ft 6 in. wide, 145 ft long and 148 ft high in the center of the building. See Figs. 2 and 3. In this well, five car hoists, one in each bay, move horizontally and vertically at the same time. From the outside, the two weblike volumes which contain the parking decks are separated by a central pier of gray glazed brick which runs the entire height of the building at each end of the shaft. On this plain surface, visible from the sidewalk, there will be a symbolic sculptural group cast in bronze, executed by the sculptor, Milton Horn.

The structure actually consists of two buildings one on each side of the open hoistway. To permit access to either side of the hoistway, passageways are included at each level, at each end of the building, as well as two stairways separated from the various levels by an incombustible wall enclosure. No mechanical ventilation is provided except in enclosed basement areas and hoistway pit. For fire protection, a dry standpipe is provided, with $2^1/_2$-in. Chicago Fire Department connections at each level, and a siamese inlet at the upper level of Wacker Drive. The required number of hand-type fire extinguishers are strategically located on each level.

Safety was an important consideration in the construction of this multi-

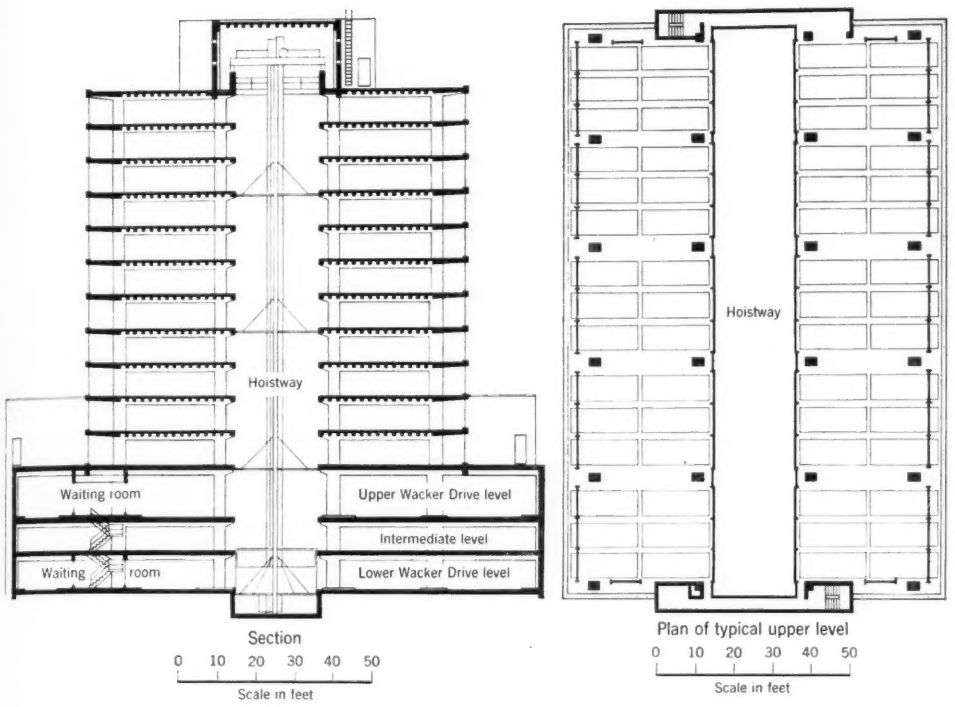


FIG. 3. Parking garage has 14 floors, 12 for parking and two devoted to entrance and exit from upper and lower levels of Wacker Drive. Typical upper-floor level is shown in plan.

story garage. If a car should accidentally jump the floor-mounted wheel barriers along the perimeter of the building, the conventional wall barriers, masonry or otherwise, would be subject to cracking or failure or could cause damage to the car. The stainless steel cable installation was developed as a means of effectively meeting this wall barrier requirement, and at a reduced cost. Little damage to a car would result from maximum impact, and if a few of the cables should become damaged, new assemblies could be installed quickly at low cost. An additional practical consideration is that the use of cables represents a considerable saving over the conventional type of wall barrier.

The design of this cable barrier was based on data gathered from several sources and from various tests. These data revealed that the fastest car acceleration for any car available at the time was 10.95 ft per sec per sec. Considering the maximum distance a car could travel from the hoist to the wheel barrier, plus the retarding effect of this barrier, the maximum speed with which a car could hit the cables was computed to be 10 miles per hr.

It was assumed that the car would hit seven cables and would impart a force equal to 2,000 ft-lb of energy to each cable. This would create a

Cable assemblies consist of $^{3}/_{8}$-in. stainless steel wire cables with turnbuckles at upper end and springs at lower end. Ends are fastened to bent stainless steel rods, threaded and embedded in concrete of roof and second floor respectively. See inset, Fig. 4. At each floor cables are threaded through stainless steel pipe sleeves of 3-in. diameter.

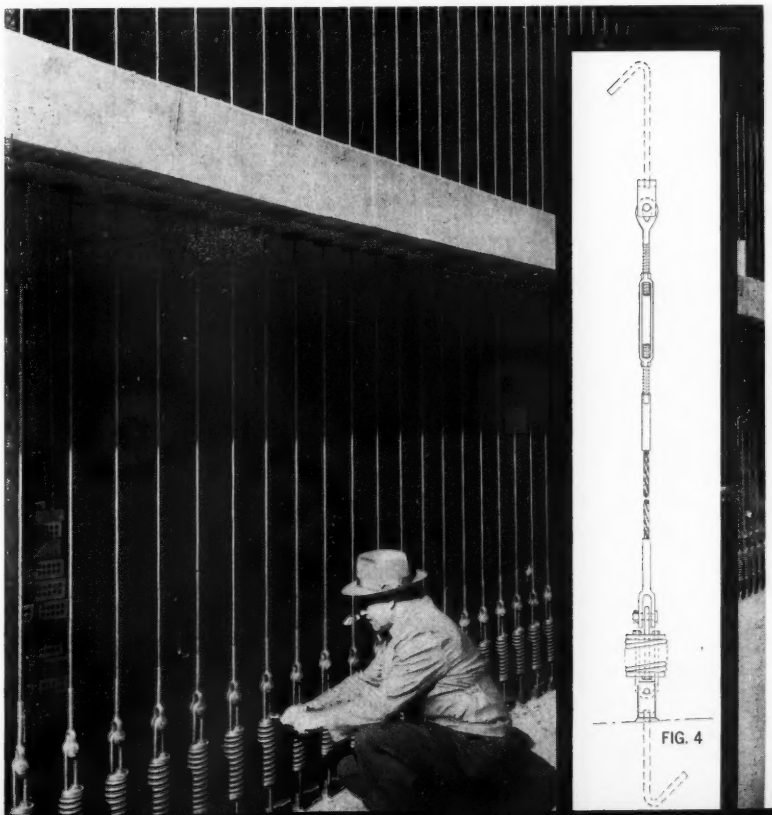


FIG. 4

tension of 10,000 lb in each cable. The maximum initial tension in the cable (which varies with the temperature at the time of erection) is 1,180 lb, which would add to the cable load caused by an accident to produce a total maximum load in a cable of 11,180 lb.

The top end of the cable assembly, as well as the lower end, is fastened to a bent stainless steel rod, which is threaded and embedded in concrete in the roof and at the second floor level. These rods are $^1/_2$ in. stainless steel equipped with a stainless steel shackle which tightens directly on the threaded end of the rod. The cable assemblies are fastened to these shackles with a stainless steel pin. Each assembly consists of a $^3/_8$-in. stainless steel wire cable, a turnbuckle at the upper end, and a spring at the lower end (Fig. 4). All fittings, as indicated in the accompanying drawing, are stainless steel and are swaged to the cable. Turnbuckles have a takeup of about 6 in. Springs are $^1/_2$-in. diameter stock with two draw-bars, compression type.

Cable assemblies are threaded through stainless steel pipe sleeves approximately 3 in. in diameter in each floor. A final step in the installation is to tension the cable, which is easily done by means of the turnbuckle and spring compression. The cable assemblies required a total of nearly 11 miles of cable.

The mechanical lift equipment around which the structure was designed is the "Bowser" Parking System, which combines vertical and horizontal operations for the five car-hoists in one open hoistway. The basic feature of this system is the use of combined elevator and crane units suspended from a bridge-type crane, so that simultaneous vertical and transverse movement is obtained from the drive-in lane to the desired parking pocket. Cars are stored in line two deep at both ends of each car hoist. Since each car hoist serves one bay of the building, the capacity is 12 automobiles per hoist unit per floor, or a total of 144 on the twelve parking levels. Protection against power failure lies in overcounterweighting the hoists. When empty, they rise and can be manually stopped at the desired level. With a car on them they coast down to ground-floor level.

Wire mesh gates are installed on the hoists and at landings on all floors, which permit free circulation of air within the building. As the hoist gate rises or drops it engages the landing gate so as to raise or lower it. The hoist gate movement is vertical, while the landing gate, of the rolling lift type, when open is in a horizontal position below the ceiling. Raising or lowering of gates is completed in 3 seconds.

As an attendant drives a car onto the elevator platform, he presses a button on the central panel, which starts the hoist upward and the carrier sideways toward the desired stall. On arrival, the attendant parks the car. The time required to deliver a car from the farthest point is approximately one minute. The signal and control systems are very elaborate and require special equipment and wiring. Panels having push buttons and various colored pilot lights are mounted in the offices, in each elevator car, and near the ceiling of the drive-in area. These lights show which pockets are in use and the push buttons are used for operation of the elevators and gates, and for setting up the lights to show occupancy.

A pneumatic tube system is used to transport claim checks from the office to the attendant's station. There is a communication system with phones in the office, in each hoist car, and at the incoming and outgoing lanes. These are for handling special movements such as taking a car to a vacant storage space in order to get a car out from the rear. However, the aim is to park automobiles so that only those left for the day are in the rear.

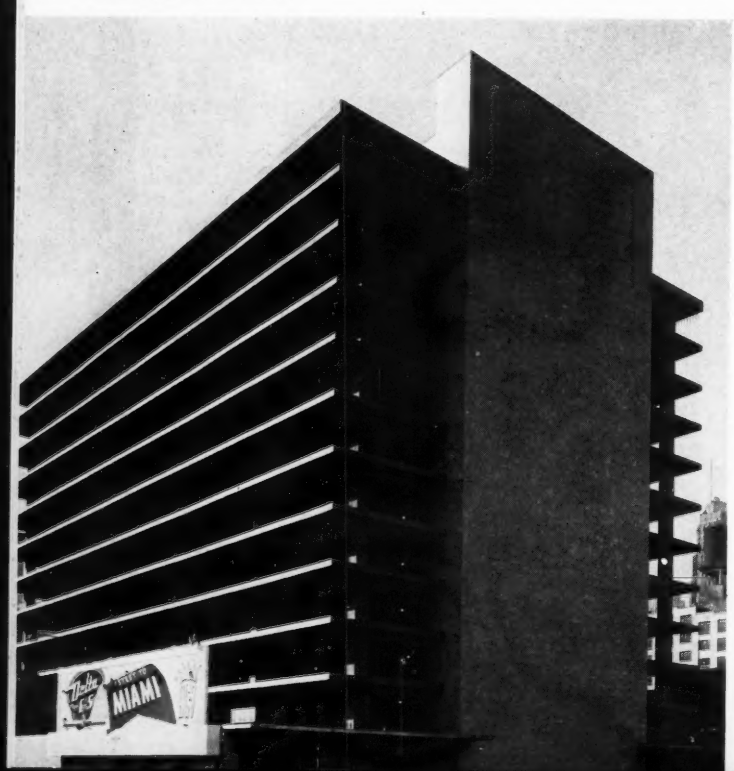
A passenger elevator gives convenient access to the upper level of Wacker Drive for motorists entering at the lower level. On the outgoing side, ample glass-enclosed waiting room facilities are provided on both levels for passengers waiting to receive cars from attendants, with control cashier and toilets on the upper level and stairway access to the lower level. Employee locker room and toilet facilities are on the intermediate parking level.

Parking Facility No. 1 is open 24 hours a day, 7 days a week. Parking fees are 45 cents for the first hour, 65 cents for the first two hours, plus 10 cents for each additional hour. Rates of $32.00 per month are available for regular daily parkers.

The total cost of this structure was $1,508,675. As there are 717 stalls, the cost per stall was about $2,104.

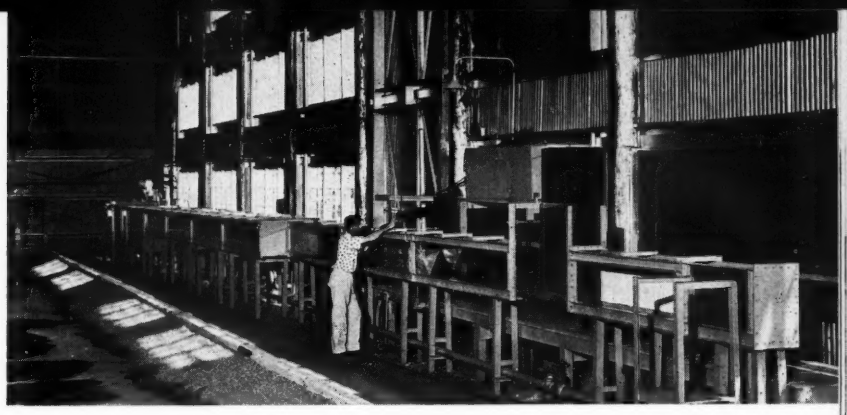
This garage was designed by Shaw Metz & Dolio, Architects and Engineers, for the City of Chicago, Department of Public Works, Bureau of Engineering, George L. De Ment, Commissioner, and Dick Van Gorp, A.M. ASCE, Chief Engineer. Herlihy–Mid Continent was the general contractor. American Steel & Wire Co. furnished cable and assemblies, which were erected by Rippel Architectural Metals, Inc.

Completed view of Chicago's Parking Facility No. 1, from upper level of Wacker Drive, shows central pier of gray glazed brick which extends entire height of building at each end of elevator shaft. Bronze sculptural group has not yet been added.



Fifth article in a series sponsored by ASCE Hydraulics Division's Committee on Research

R. Y. HUDSON, M. ASCE, Hydraulic Engr.
Waterways Experiment Station, Vicksburg, Miss.



WAVE RESEARCH at Waterways Experiment Station

Wave studies conducted at the Waterways Experiment Station (the Corps of Engineers, Department of the Army, laboratory at Vicksburg, Miss.) are concerned principally with harbor models and the stability, absorption and reflection characteristics of breakwaters, bulkheads, wave absorbers, and other harbor and shoreline structures.

Harbor wave-action models are used to study problems involving the selection of the most efficient type, length and alignment of breakwaters; the location, alignment, shape and width of navigation openings; and the effects of vertical-wall bulkheads and wave absorbers on wave action within harbors.

Breakwater stability and wave absorber models are used to determine wave forces on impervious, vertical and inclined walls; the stability of cribs and caissons; the optimum design of rubble breakwaters; the variation of wave runup and overtopping of breakwaters and sea walls with wave dimensions and cross-sectional shape of structures; the design of wave absorbers; and the study of other similar structures subjected to wave action.

Harbor models are constructed in concrete wave basins, two of which are in use at the Experiment Station at the present time. One of these basins is 1.5 ft deep, 50 ft wide, and 115 ft long. The other is 1.5 ft deep, 75 ft wide, and 100 ft long. Each basin is equipped with plunger-type wave machines (40 ft and 60 ft long, respectively) and electrical wave-height measuring and recording apparatus. Photographic equipment includes a 40-ft-high platform and an electronic-flash lighting unit which are used to obtain photographs of wave-front patterns covering all the harbor area under investigation.

Studies of breakwater stability and wave absorbers are usually conducted

FIG. 1. Small wave flume (also shown in photo) is designed to allow generation of larger waves in shallow water, as compared with two larger wave flumes at Waterways Experiment Station. Recent tests were concerned with effect of hurricane-generated waves on levee sections along shallow Lake Okeechobee.

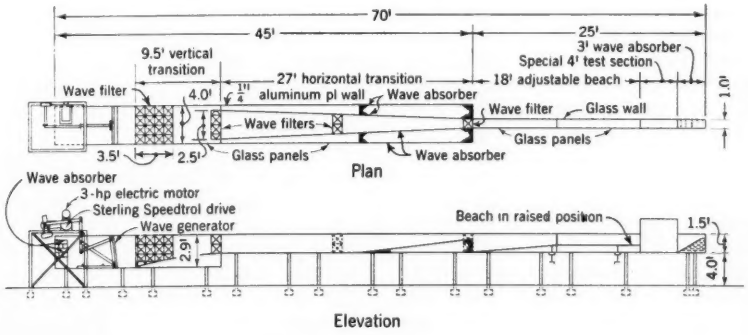
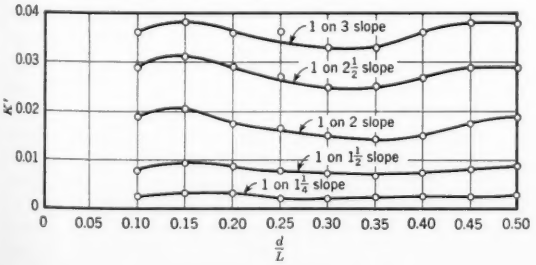


FIG. 2. For rubble breakwaters constructed of quarry stone, tests conducted in one of two large wave flumes show that dimensionless constant K' varies considerably with α (angle of breakwater slope) and d/L.



Iribarren's formula is: $W = \dfrac{K'\gamma_w^3\gamma_r\mu^3H^3}{(\gamma_r - \gamma_w)^3(\mu\cos\alpha - \sin\alpha)^3}$ in which

K' = dimensionless coefficient
γ_w = specific weight of liquid in which breakwater is constructed, lb per cu ft
γ_r = specific weight of cap rock, lb per cu ft
μ = effective coefficient of friction between rock
α = angle of breakwater slope
H = height of design wave, ft
d = depth of water at breakwater, ft
L = wave length in depth d, ft

Conditions for the test reported on in Fig. 2 were such that $W = 0.297$ lb; $\mu = 1.10$; $d = 2.0$ ft; $\gamma_r = 176$ lb per ft^3; and $\gamma_w = 62.4$ lb per ft^3.

in wave flumes, three of which are in use at the present time. Two of these flumes are within a concrete tank with a common sump between. The tank is 18 ft wide, 5 ft deep, and 120 ft long, and is equipped with plunger-type wave machines and glass viewing windows at the positions of test structures. Each wave flume is 4 ft deep, 5 ft wide, and 90 ft in length, measured from wave machine to glass viewing window.

The third wave flume has a steel frame with glass and sheet-metal side walls. This flume, the details of which are shown in Fig. 1 and the accompanying photograph, is equipped with a wave generator of the rigid-flap type, with double articulation. Although smaller than the two flumes previously described, it is designed to allow generation of larger waves in shallow water. After generation by the rigid flap, the waves are increased in height by vertical and horizontal transitions and a sloping beach. Wave filters eliminate a larger percentage of the undesirable parasitical waves which are superimposed on the test waves, and allow propagation of waves with higher steepness ratios (H/L).

In one side of the large wave flume a model study of wave runup and overtopping of sea walls of various types is being conducted using a linear scale of 1:17.

In the other side of the large wave flume, a general study of the stability of rubble-mound breakwaters is in progress. Tests have been completed for breakwater slopes from 1 on $1^1/_4$ to 1 on 3, and d/L ratios from 0.10 to 0.50. The results of these tests, when presented in the form of dimensionless coefficients for use with the Iribarren formula, show that the coefficient K' is not constant, but varies appreciably with the side slope of the mound and the ratio d/L. (See Fig. 2.) Tests now in progress are being conducted to determine the safety factor provided by these coefficients. Preliminary tests indicate that the shape of cap rock and the percentage of voids also affect the stability of rubble breakwaters. Tests similar to those conducted for quarry-type rock are planned for breakwaters made of concrete blocks, tetrahedrons, and tetrapods.

Tests conducted recently in the small wave flume were concerned with wave runup and overtopping of Lake Okeechobee levee sections caused by hurricane-generated waves. The ability of this flume to generate large waves in shallow water was especially useful in these tests. Lake Okeechobee is very shallow, with short fetches, and hurricane winds generate large waves with high steepness ratios. Reports on these studies are in preparation.

COMPETITIVE BIDDING —

RAYMOND A. HILL, M. ASCE

Until about thirty years ago the private practice of engineering was generally limited to individuals; since then, and particularly during the past ten years, the field of the individual consultant has narrowed and many of his functions have been taken over by large engineering firms. This trend from purely professional service to mass production of plans and specifications is but one of the results of the impact of modern business on the practice of engineering.

Far-reaching changes in thirty years

Many of us can remember when few consulting engineers had more than five engineers on their staffs; some even had none. I can recall the time an engineering office with fifty employees was something to be talked about in hushed tones. There were none on the Pacific Coast, probably none in the South, and very few in the Middle West. In those days, not too long ago, many consulting engineers deemed it beneath their dignity to seek employment. In their minds, and in the minds of most of us in private practice at that time, only quacks competed for work on a price basis. It was in this atmosphere that our Code of Ethics was drafted.

What has happened during the past thirty years, especially during the past ten, that makes this brief recital of what used to be accepted as natural, appear fantastic to the younger men of our profession? Perhaps the answer to this question cannot be stated precisely, but what has happened can be attributed to fundamental changes in the social and economic structure of this country.

For example, it is no longer possible to operate even a small engineering office without much more overhead than used to be the case. Complete payroll records must be kept, deductions must be made for old age benefits and unemployment insurance to comply with new federal and state laws, and federal income tax must be withheld from the pay of every employee. All such deductions and withholdings must be reported regularly to the proper authorities and there are severe penalties for failure to do so. This increased burden on the cost of maintaining an engineering office has been one of the causes behind the formation of large organizations in which the volume of such non-productive work justifies employment of qualified accountants. Other social legislation has stemmed from the philosophical concept that one workman is as good as any other, one craftsman equally as skilled as another, one professional engineer as capable as another.

Although some of these laws were not then in effect, conditions were ripe for the creation of large engineering organizations when the Federal Government started its great program of defense in 1940. During the latter part of that year and throughout 1941 and 1942, long-established engineering firms had to be expanded many-fold to carry out work assigned to them, and many new synthetic organizations were put together for the sole purpose of preparing plans and specifications for military camps and other work connected with military operations.

The result was that engineering firms with one hundred or more men on the payroll became commonplace throughout the United States. The gross income of many such engineering organizations exceeded a million dollars a year. The rendering of personal service became almost non-existent. Speed of production of engineering plans and specifications was the prime object. Time did not permit of original engineering designs; it was not even desired by the military authorities. They on the contrary prescribed standards for almost every conceivable item of work. Those engineering firms who tried to inject their opinions as to a better engineering solution of a particular problem only caused trouble for themselves. In brief, the efforts of individual engineers were subordinated during the war to mass production of drawings and specifications.

At the end of the war, with the return of men from the service, there was pressure on every engineering organization, old or newly formed, to obtain enough work to maintain the organization at substantially the size that had been customary during the war. The new firms created to carry out mil-

Impact of modern business on practice of engineering

Chairman, ASCE Committee on Professional Practice; Leeds, Hill & Jewett, Consulting Engineers, Los Angeles, Calif.

itary assignments had no backlog of old clients upon whom they could rely for continued business, but even the old firms had to seek new clients to secure a volume of business several times that to which most of them had been accustomed before the war. The competition for new engineering contracts has therefore been much more intense during the past ten years than ever before in the history of our profession.

Premium on quantity production

The premium necessarily placed on quantity production of plans and specifications during the war is still having its effect, although the necessity no longer exists. For example, most of the engineering firms in this country have been asked from time to time by federal and other governmental agencies to submit their qualifications by filling out elaborate questionnaires. Almost invariably these questionnaires are directed to the size of the organization. The questions asked are: How many civil engineers, mechanical engineers, electrical engineers and other specialists are on the payroll? What is the area of the office space that the firm has or could immediately obtain? What is the financial standing of the firm? What was the construction cost of work for which plans and specifications were prepared by the firm in the last five years? Ad infinitum, ad nauseam. Rarely is interest evidenced in the particular qualifications of the partners or other principals of the engineering firm. The general statement can almost be made that the professional qualifications of the owners of an engineering firm are not considered except where an individual is needed as an expert witness or for the solution of some specialized problem.

Impersonal consideration of the qualifications of engineering firms is also characteristic of public utilities and large industrial corporations. No longer is it possible for the executive heads of such businesses to handle personnel matters or the procurement of other services. These responsibilities are delegated, usually to a personnel manager or to a purchasing agent. The former is fully trained to select employees of the business but he rarely has the background for selecting an engineering firm. The latter is by training and experience concerned primarily with the price of whatever he buys, be it goods or services. Even if the selection of an engineering firm were not delegated, the effect would be much the same. Most modern corporation executives do not see much difference between the employment of a construction contractor and his organization of skilled personnel and the employment of an engineer and his organization of skilled personnel. The feeling is: If one should be selected on the basis of competitive bids, why should not the other?

Influence of construction industry

This feeling stems from the fact that great changes have also taken place in the construction industry. Thirty years ago most contractors had started out as mechanics or foremen. At that time there were few professional engineers employed directly by construction firms and these were generally engaged on layout work and estimating. Today the situation is very different; the construction industry has become much more professional in nature; engineers head some contracting firms and many engineers now direct actual construction operations.

These men, many of whom are members of the American Society of Civil Engineers, accept the principle of competitive bidding for the services of their organizations; in fact the construction industry demands that competitive bids be taken on all public work and it exerts great influence to have competitive bids taken by private industry.

Today services must be sold

The complications of modern business also have a direct bearing on the operation of engineering organizations. The heads of any large firm must be administrators; they must also, from the very nature of their business, be the sales force. Little time is left for any of them to render professional service as such service was rendered by consulting engineers thirty years ago. In common with all large industry, the business of selling the services of a large engineering organization has become fully as important as the production of the finished product, which in this case consists of plans and specifications for the construction of engineering works.

Much has been said recently about guaranteed annual wages in industry as if a guaranteed annual income were something new. It is as applied to industrial workers paid on an hourly basis, but it has long been in effect in governmental organizations that employ large numbers of engineers. These federal and other public agencies offer security; private engineering firms must do likewise to retain their staffs. These firms must in effect guarantee the annual income of at least all their key men.

Many of my friends have created Frankensteins in the form of very large staffs; they must feed these Frankensteins new business every month or be themselves destroyed. Payrolls of $50,000 or $100,000 or $200,000 per month cannot be met without constantly obtaining new contracts for engineering services. Not many firms can obtain the requisite amount of new work month after month purely on the basis of the professional qualifications of the principals and the key men of the organization.

In our modern economic system, sales of any commodity are sensitive to the price placed on that commodity. The buyer of engineering services may recognize that the value of the service of one firm is greater than the value of the service of another but he has the right to demand that the sale price of such services reflect these differences.

These are some of the reasons why our Code of Ethics has been challenged. I leave with you the question: How can the prohibition against competitive bidding on a price basis be administered so as to best serve the public interest?

(This paper was originally presented by Mr. Hill at ASCE's St. Louis Convention, before the Conditions of Practice session devoted to the "Impact of Modern Business on Engineering Practice." The session was presided over by Mason G. Lockwood, Vice President, Zone IV.)

WELDED BRIDGE

speeds oil cargo handling from floating dock

With the inauguration of a $2,000,000 expansion program at its Gretna, La., cargo terminal, the Gulf Refining Company found it necessary to modernize its wharf facilities there. Package goods on pallets and bulk petroleum products must be handled simultaneously.

Gretna, across the Mississippi from New Orleans, is a distribution center for a large part of the company's New Orleans Division serving a six-state area. All package material comes from Port Arthur, Tex., and is put on 4-ft × 4-ft double-faced pallets direct from canning plants, thereby effecting tremendous savings in subsequent handling. Fork-lift trucks handle the largest pallets of 2,500 lb with ease and greatly simplify inventory work and stock rotation. The package goods consist of automotive and industrial oils and greases in containers of various types and sizes.

Before the new wharf was built, package goods were handled as individual units and required approximately 60 or more men working continuously to unload the barges on the old, dilapidated, unstable wharf. With construction of the new facility, 7 men do the same job in the same time, with a reduction in handling costs from approximately $4.00 per ton to $0.50 per ton. The 7-man crew consists of one crane operator, one tractor driver, two fork-truck operators in the warehouse, two men in the hold of the barge, and one foreman on the deck. One-ton pallets are unloaded continuously at the rate of approximately 40 per hour.

The new wharf consists of four barges anchored by 90-ft timber pile mooring clusters located approximately 300 ft from the center line of the levee (Fig. 1). The depth of water at the low-water stage of about El. 0, Mean Sea Level, is 15 ft. Pile clusters penetrate approximately 50 ft below the mud line. The two downstream barges are 150 × 35 ft and the two upstream barges 116 × 37 ft in plan and are used for unloading both package goods and bulk petroleum products simultaneously.

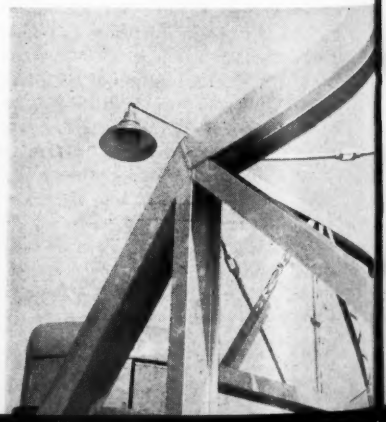
Package goods are unloaded from 600-ton barges by a Lorain crane mounted on the bridge, onto trailers, on which they are transported to warehouses on shore, where they are stored for future distribution. Liquid petroleum products are pumped from the barges through pipelines to shore storage tanks for further distribution.

Design of bridge, main problem

Key to the efficient operation of the wharf facilities is the bridge, which spans the unstable bank, connects the shore with the floating dock, and carries the main cargo-handling facilities. The major design problems encountered in the design of this bridge were: (1) properly locating the crane; (2) designing a universal joint at the fixed pier end of the bridge which would permit the barge end of the bridge to rise and fall

Problem of unloading bulk and packaged petroleum products simultaneously at high speed, with varying river level, was solved by use of all-welded steel bridge connecting floating wharf to shore. Bridge carries pipelines, crane, and runway for tractor-drawn trailers. Note setback in levee beyond right end of bridge, to avoid deep-seated fault line which runs along this stretch of Mississippi River.

Welded connection at upper chord is typical of all panel points. All main-truss members are 14 WF rolled beams. Top and bottom chords are fully continuous with butt-welded splices.



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Department of Civil Engineering

Tulane University, New Orleans, La.

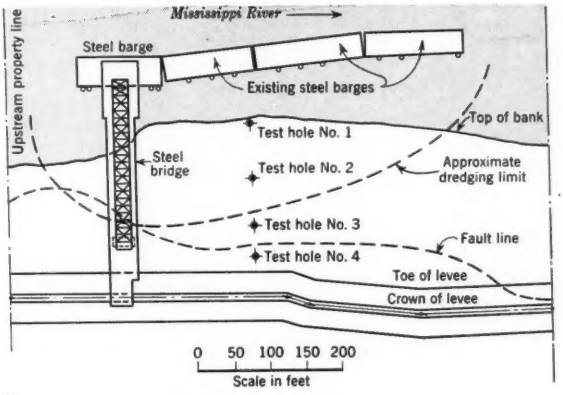


FIG. 1. Floating wharf of Gulf Refining Company is located at Gretna, La., just across from New Orleans. Note location of test holes, dredging limit, fault line, and levee (with bend to avoid fault line).

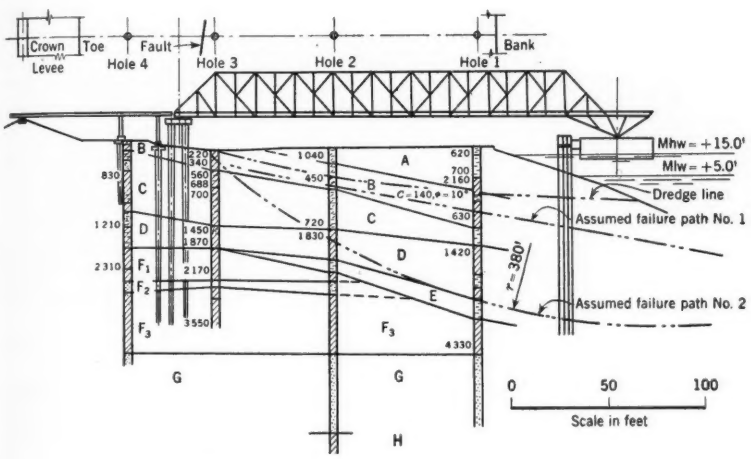
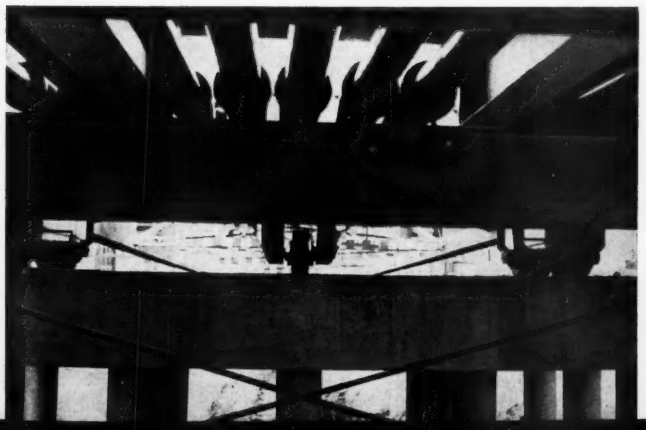
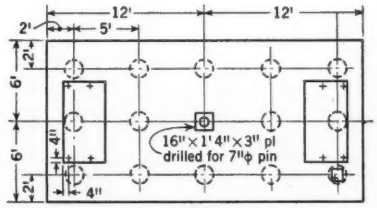


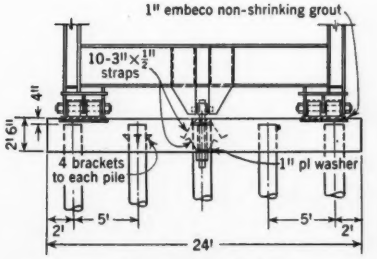
FIG. 2. Cross section through site gives typical soil profile, boring logs, and failure paths. Figures to left of boring logs indicate unconfined compressive strength in psf. Symbols for strata are: *A*, soft to plastic gray clay, silt to silty clay; *B*, soft gray clay and silt; *C*, soft to plastic silty clay, silt generally varved and jointed; *D*, plastic gray silty clay and silt, varved; *E*, firm gray silt to sandy silt; *F*, stiff gray clay with few shell fragments; *G*, fine white sand, some humus; *H*, stiff gray clay.

FIG. 3. Anchor pier and universal joint support landward end of steel bridge. Pier cap was cast in place; reinforcing steel is not shown. In photo below, universal joint on anchor pier for steel bridge is seen from land side. Center pin has 7-in. diameter.

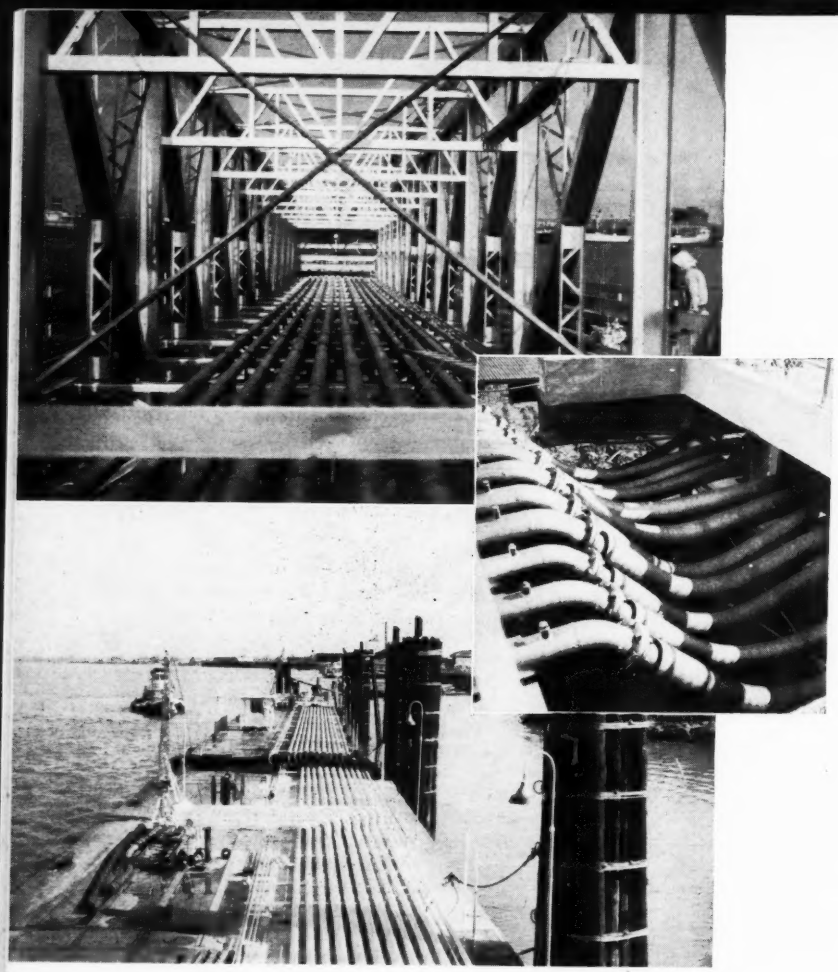




Plan



Longitudinal section



Pipelines run through center of bridge (top), have flexible hose connections at anchor pier (center), then extend along floating dock (lower view). Note deep transverse framing of all-welded bridge to take torsional stresses due to pitching of barge on which outer end rests.

with varying river stages from Els. 0 to +20 M.S.L.; (3) designing a cradle for the barge end of the bridge to rest in; (4) selecting a commercially available grating that would be permanently self-cleaning and easy to clean of oil or grease and with adequate traction features for the tractor and trailer wheels operating on the 5-percent grades encountered at high and low river stages; and (5) design of upper- and lower-chord lateral bracing adequate to permit torsional rotation of the bridge about the longitudinal axis within the elastic range as the supporting barge pitches.

A small-scale model of the final design was made by a senior civil engineering student at Tulane University, William Mouton, and operational features were carefully checked by the Materials Handling Division of Gulf Refining Co.

The bridge was located at the upstream end of the wharf for two reasons. In the event of fire the flow of water would carry the petroleum products away from the steel bridge, thereby protecting it from collapse due to heat. At the downstream end of the wharf, a bridge of longer span would have been necessary, as the fault line comes in closer to the levee there.

It is to be noted that the base of the crane is located 10 ft above the deck, and the vertical center of rotation is 26 ft back from the face of the wharf. This position enables the crane operator to view operations in the barge and on the deck, thereby simplifying operation, saving time, and reducing accident hazards.

Bank stabilization can be accomplished with relative ease by annual dredging behind the wharf. As usual, considerable silting occurs as the high flood waters recede. Since the wharf is located on the concave bank, the natural cutting action of the channel results in annual slides of varying extent depending on the amount of silting. Accumulation of driftwood is reduced to a minimum as compared with the conventional type of pile-supported structure, and this results in further savings.

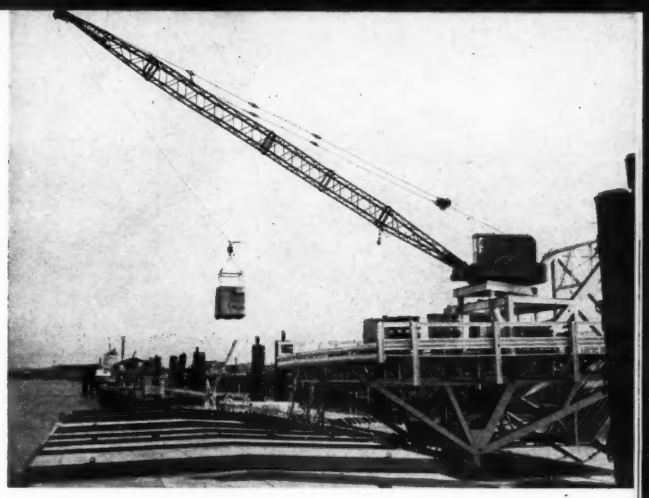
Soil profiles drawn from the results of the borings show that the soil underlying the area between the levee and the river bank may be divided into eight fairly distinct strata, as indicated in Fig. 2. All material above stratum *F* is a recent geological deposit and is essentially the same type of soil, differing chiefly in consistency and in the clay-silt ratio. Stratum *F* is a Pleistocene formation, but the oxidized upper part usually found in this locality has apparently been removed by the scouring action of the river. A layer of silty sand containing clay streaks and shell fragments (stratum F_2) exists between El. −56 and −61 M.S.L. within stratum *F* at all borings except hole no. 1, where it has apparently been washed away by the river. The bottom of stratum *F* is nearly horizontal.

The upper surface of stratum *F* and all overlying strata show a distinct slope toward the river and also in the downstream direction. The average slope of strata toward the river is about 10 deg. The thin layers in many of the soil samples showed definite inclinations with the horizontal of approximately 10 deg.

A comparison of the unconfined compression tests (Fig. 2) shows that stratum *B* has a lower average shearing strength than any other stratum. Many samples from both strata *B* and *C* contained joints, splits, and shear failure planes, indicating that movement had occurred within these strata.

A study of data obtained from the U. S. Engineer Office developed the following facts concerning this section of the Mississippi River. A subsidence or slide occurring over a considerable part of the batture, in August 1945, caused the U. S. Engineer Office to make a study of the stability of the levee at this point. The inner limit of this subsidence was marked by a fault line showing both vertical and horizontal movement. This line began about 750 ft upstream from the Gulf Refining Company's wharf, reached its greatest depth by cutting into the levee at a point about 530 ft downstream from this wharf, and then continued in the batture some distance below the Gretna Ferry Landing, making a total length of nearly a half mile. This fault line is still visible.

The subsidence in 1945 occurred following a rapid recession of the river from a stage which had flooded the



Cargo barge is unloaded by MC-424 Lorain crane with 70-ft boom, which here lifts 2,500-lb pallet at 60-ft radius to trailer on bridge. Crane operator can see inside of barge and trailer simultaneously. In right foreground, note 16-in. cast-steel rollers at outer end of bridge which bear on cradle built into steel bridge barge to provide for pitching and 20-ft variation in water level. In lower photo, pallet is lowered onto trailer.

batture. Data gathered after the 1945 subsidence showed considerably more vertical movement than horizontal, and were considered to indicate either deep-seated rotation along assumed Failure Path No. 2 or the horizontal squeezing out of the material from a soft stratum.

Immediately downstream from the Gulf wharf, the U. S. Engineers have set the levee back to prevent any further subsidence from cutting into it. See Fig. 1 and the aerial photograph. The high shearing strength of all material below stratum *C* indicates that a slide would occur along failure path No. 1 rather than No. 2. Some samples from stratum *D* showed evidence of movement, but it is believed that this occurred many years before this stratum had consolidated to its present degree. The formation of the theoretical circular-arc shear failure path from the 1945 fault location would necessitate cutting into stratum *E* or *F* along failure path No. 2.

Considering the average cohesion of the soil within stratum *B* to be 250 psf and neglecting friction, the factor of safety against the occurrence of a slide along the assumed failure path No. 1 is about 1.2 at mean low water. It is believed that deposition of about 4 ft of soil over the area during a high-water period would increase the load sufficiently to make the occurrence of a slide very likely.

Observation of the timber structure that was in service at the same location for many years indicated that a deep-seated slide was occurring. Piles close to the fault line sank several feet while the mooring clusters "walked out" in a vertical position. In the period 1945–1950 the clusters moved out 11 ft. These clusters were in the same location as the present ones.

To stabilize the bank for the new wharf, the bank was dredged to a depth of El.−15 M.S.L. beneath the barges and then up a slope of 1 on 10 to the intersection with the existing ground line. It is thought that if this level is maintained annually, further excessive bank movements will be prevented.

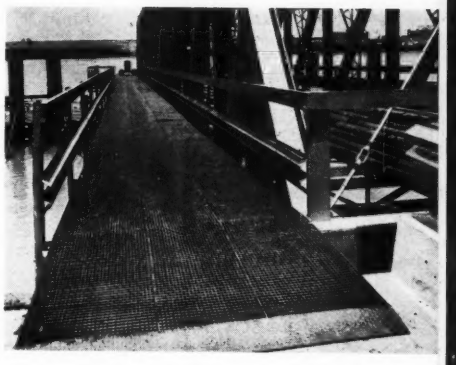
All-welded bridge 244 ft long

The all-welded bridge spans 226 ft between center lines of bearings, and has a total length of 244 ft. Basic design criteria are:

1. Live load is 100 psf over all grating area.
2. Pipe load is 1,000 lb per lin ft of bridge.
3. Total crane load of 33,280 lb shifts from center of rotation to a point 10 ft out in any direction. This allows for eccentricity of a 3,000-lb pallet load at a radius of 65 ft.
4. Wind pressure is 30 psf on $1\frac{1}{2}$ times projected area of both trusses and on projected area of crane.
5. A pitch of 1 deg is allowed in supporting barge.
6. Pick-up points for erection were at any of the top-chord panel points. Bridge is designed to be picked up at center or at two ends as desired.
7. Horizontal load on barge rollers of 100 kips was arrived at by using friction factor of 0.29 on total bridge reaction on barge. This was done in the event that the rollers would lock.
8. Bridge is to be level at river level of El. + 8.1 M.S.L.

Basic design criteria for the grating proper was the wheel loading furnished by the tractor trailer system and is discussed elsewhere in this article. Design stresses were in accordance with 1949 AISC Specifications.

The bridge consists of two Baltimore trusses with subverticals and subdiagonals. All main members consist of 14 WF members with the webs in a horizontal plane rather than a vertical. Top chords are continuous 14 WF 95, bottom chords continuous 14 WF 84.



Along each side of bridge is a cantilevered deck runway for tractor-drawn trailers, with hinged section resting on concrete approach deck (upper view). Roadway is 7 ft 6 in. wide with Gary welded grating spanning 10 ft and widened to 15 ft near river end. View from below (right) shows 15-ft cantilevered roadway trusses on 10-ft centers. Note 3-in. I-beam stiffeners approximately at third points.

All diagonals and verticals are 14 WF 43. Subverticals and subdiagonals consist of laced angles. The 14 WF was used throughout so that, regardless of weight, the flanges would align for butt-welding. Chords were fully butt-welded while diagonals and vertical members were butt-welded to the chords through the flanges only. The webs of the diagonal and vertical members were coped with a semicircular cut to reduce stress concentration. Gusset plates were not used. Trusses are 20 ft on centers and 20 ft high.

The tractor trailers run entirely on the outside of the bridge, on cantilevered deck runways, one on each side of the bridge. These runways are 7 ft 6 in. wide, then widen out to 15 ft at the barge end for a distance of 60 ft. At the barge end they connect with the loading apron, which is 25 × 50 ft. Cantilevered trusses are 10 ft on centers coinciding alternately with the subverticals and main panel points. Top-chord and bottom-chord lateral bracing consists of round and square rods with a maximum $1^3/_8$ in. square and 2 in. round. All square rods have upset ends.

The crane, mounted on the bridge, has a base support which can be leveled at high- and low-water stages by hand-operated worm gear.

The bridge is supported by a moored steel barge 116 × 36 ft which has built-in steel cradles to support the four 16 in. round × 14 in. long rollers. The cradle is flat or horizontal in the center part for a distance of 42 in. and then rises 4 in. in 51 in. on the sides. The slope was set so that the bridge would always resist further barge movement inshore or out and automatically center the barge. All rollers have alemite grease fittings. The cradle consists of a 2-in. bent plate bearing on three 20I85 steel beams set into the barge. The total design-load reaction of the bridge on the barge was as follows: 220-kip dead load plus 100-kip pipe load and 33.0-kip crane load, or a total load of 353.0 kips. The unloaded barge draws 3.36 ft, and with the loaded bridge draws 4.65 ft. From high to low water the rollers move 9 in. owing to the fact that the barge rollers are 8 ft 6 in. lower than the anchor-pier rollers. Compartments in the barge permit it to be leveled if necessary to offset listing.

At the pier or fixed end, a universal joint was designed to permit the barge end of the bridge to move up and down with river levels varying from Els. 0 to + 20 M.S.L., and in addition to permit the barge end to move up or downstream a distance of 30 ft. The detail, shown in Fig. 3, consists of four 16-in.-round × 14-in.-long, cast-steel rollers with a cast-steel universal joint attached to a 7-in. round steel pin. The joint and all fastenings were designed for a horizontal load of 100 kips. Rollers and universal joints have alemite grease fittings.

The pier was designed for a vertical bridge reaction as follows: dead load 180.2 kips, pipe load 100.0 kips, live load 62.4 kips, friction effect 3.4 kips, or a total of 346 kips. In addition, the total horizontal load of 100 kips was applied to the top of the pier. Wind force did not affect the design of the pier or the barge.

The pier consists of a reinforced concrete cap 2 ft 6 in. × 12 ft × 24 ft, resting on fourteen 16-in. round steel-pipe piles driven with closed ends and subsequently filled with concrete.

Liquid petroleum products are pumped to shore from barges through pipelines of various sizes. The pipes run along the center of the bridge between the trusses, completely separate from the tractor-trailer runways, assuring that one operation does not affect the other. Flexible hose was used at each end of the bridge to permit free movement.

The bridge was fabricated in one piece at the Avondale Marine Ways several miles up-river from the site, barged down the river, and lifted into place with two derricks. The weight of the bridge minus the steel grating and crane was 140 tons.

Trackless trailers move packaged goods

Six all-steel Mercury Type A-310 trailers, with roller-bearing castor steering assembly, are pulled by a Clarktor 30 gas-powered towing tractor. The tractor weighs 3,685 lb and its six-cylinder Chrysler engine produces a draw-bar pull of 3,000 lb, adequate to operate the fully loaded trailer system on the 5 percent grades encountered at extreme high and low water. Trailers weigh 520 lb each and handle 2,500-lb pallets; their flat tops are 5 × 5 ft to handle the 4 × 4-ft pallets. The tractor has a pneumatic 7.50 × 16 rear drive and 6.00 × 9 front steering tires. The trailers have 10 × 4-in. front and 12 × 4-in. rear molded-on rubber tires. Both have excellent traction on the open-grid welded grating.

For design purposes the wheel loading was 1 kip followed by 1 kip at 5 ft; 0.755 kips at 4 ft 7 in.; 0.755 kips at 2 ft 4 in.; 0.755 kips at 4 ft 2 in.; 0.755 kips at 2 ft 4 in.; 0.755 kips at 4 ft 2 in.; 0.755 kips at 2 ft 4 in., etc., depending on the number of trailers. An impact factor of 30 percent was used.

The grating used throughout the roadway is Gary welded grating SGW-225 with $2^1/_4$ × $^3/_{16}$ main bars 0.915 on centers and $^3/_8$-in. hexagonal cross bars $1^1/_2$ in. on centers. The grating was furnished in panels 40 × 2 ft, end banded with $2^1/_4$ × $^3/_{16}$-in. bars. Practically 100-percent continuity was provided over supports by welding panels end to end. The grating spanned 10 ft, and to the under side 3-in. I-beams were welded at points 3 ft from the supports to distribute concentrated loads and reduce deflections. All panels were side welded to adjacent panels.

Crane with boom hoist

The crane is an MC-424 superstructure mounted on a special ring gear and roller path which adapts itself to this particular mounting very readily. Turntable rollers are roller bearing and most accessible for easy adjustment. The crane can be powered with a selection of either gas or diesel engines and is equipped with a boom hoist which is power controlled. Boom hoist or topping lines are so arranged through a harness that the boom length can be varied without disturbing the hoist cable. Socketed cable sections the same length as the center boom sections can be inserted or removed as the boom length is altered.

The sheave arrangement at the end of the boom permits the use of 6-part derricking lines without additional blocking. The cable boom stop and boom-hoist declutching mechanism are safety features incorporated in the basic machine.

Maximum capacity of this machine is $22^1/_2$ tons at a 10-ft radius with a 30-ft boom. In the Gulf installation, a 70-ft boom has been used with a capacity of 3,000 lb at a 65-ft radius.

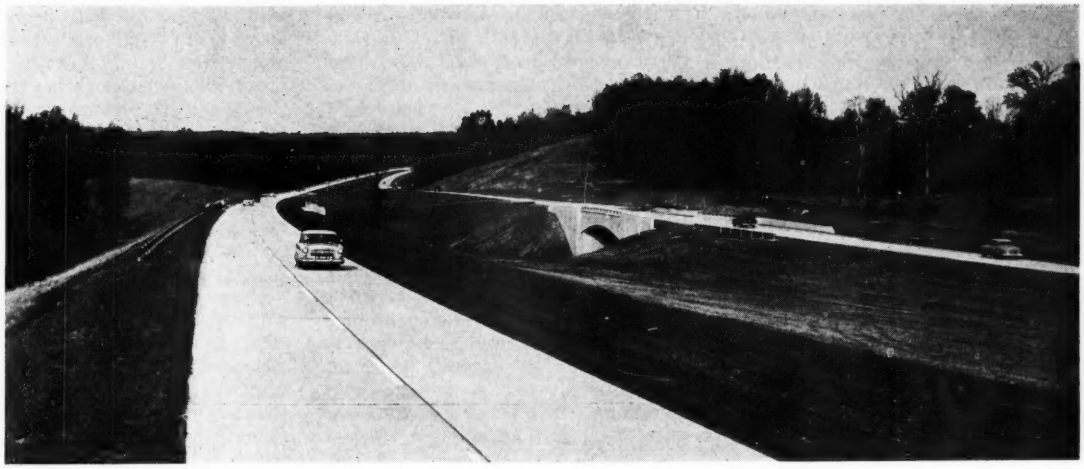
Cost of bridge

A cost breakdown for the bridge, including everything from the top of the levee to the barge bearings, is as follows:

140-ton bridge barged to site	$ 60,000
Erection	6,000
Field painting	2,000
Crane delivered to site	18,000
Crane installation	3,000
Decking delivered, 60 tons, 5,900 sq ft at 2.69 per sq ft	16,000
Deck installation	4,300
Approach from levee to pier, including pier	43,000
Total	$152,300

Since June 1954, the wharf installation has been functioning as designed.

The writer was responsible for the conception, design, and general supervision of construction; Prof. John K. Mayer of Tulane University was Soil Consultant; E. J. Mackie represented the Gulf Refining Co.; bridge fabrication was by the Avondale Marine Ways, Avondale, La.; erection was done by the J. Ray McDermott Co., Harvey, La.



OUR INTERSTATE HIGHWAY SYSTEM—

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This is the second of two parts into which Mr. Barnett's paper on the design of our Interstate Highway System has been divided for purposes of publication. The first part, dealing with new design standards as related to traffic needs, appeared last month. The entire paper was originally presented at the ASCE St. Louis Convention, before the Highway Division session presided over by Emmett H. Karrer, Vice Chairman of the Division's Executive Committee. In this second part Mr. Barnett discusses the many advantages of control of access, the dangers of too great standardization, and the practical role sound esthetic principles can play in the design of our national highway system—which should be a system of which we can all be proud.

II. Controlled access and esthetic design have proven economic value

One of the most important items included in the standards now being considered by the American Association of State Highway Officials, and accepted in the Clay Committee Report[7], is the provision for control of access. The standards call for full control of access except on highways in sparsely settled rural areas which are sufficient distances from municipalities or other traffic-generating areas to be outside their influence, where the DHV-current is less than 300, and the DHV-20 is less than 600 vph. (DHV = 30th highest hourly volume; vph = vehicles per hour.) On such highways, lightly traveled public roads and private driveways with little potential for traffic increase may be permitted to intersect at grade provided that such intersections do not exceed two per side of the interstate highway per mile, that the traffic on the intersecting highway does not exceed 50 vehicles per day, that access rights between such connections are acquired, and that additional corner right-of-way is acquired to insure that access connections on the crossroad are sufficiently removed to minimize interference with the interstate highway. Where such conditions are not met, the standards envision ultimate full control of access.

The struggle for developing controlled-access highways has been going on for a long time, but with the experience gained in each state as a controlled-access highway is put in operation, there is increasing acceptance of this important element in design. Particularly convincing has been the experience in recent years with toll roads, which are highways with full control of access but with a limited number of access points. Nevertheless we still see many important highways, even those constructed on new right-of-way, without provision for access control. How long will these facilities serve their intended purpose? How soon will obsolescence creep in?

These questions are not concerned with speculation as to how soon traffic on these facilities will increase to the point where they are overloaded, assuming that the roads retain their capacity. The answer to that question in an individual case depends upon the leeway between capacity and traffic load at the time the improvement is made and the rate at which traffic increases. Nor do these questions refer to obsolescence in the generally accepted meaning of the term—that is, design which proves in time to be inappropriate to meet the changing characteristics of the motor vehicle and possibly of the driver.

These questions are concerned with a type of obsolescence which develops in spite of adequate maintenance, and even though traffic volume does not increase beyond design capacity and the characteristics of the motor vehicle and of drivers remain constant. Under these assumptions a highway should last forever. At any future time it

should have as great a capacity to handle traffic as it had when originally constructed.

Then why do so many of our roads, in a few years, fail to satisfy traffic needs despite the favorable conditions just cited? The answer clearly is one of interference with the movement of traffic by vehicles and pedestrians which enter from the roadsides at will because of a lack of access control. Without control of access the increasing interference from the roadsides steadily reduces the capacity of a highway and increases its accident potential from the time it is opened to traffic. This is particularly noticeable on arterial highways within the influence of urban areas. The conglomeration of roadside businesses, with their varied and blatant signs vying with one another for the attention of travelers, is a direct cause of continuing capacity reduction and accident increase.

If we add to the factors of decreased capacity and increased hazard, the contribution of uncontrolled roadside development to the unsightliness of the arterial routes which form the gateways to our cities, and their depressing effect on nearby land values, one wonders why uncontrolled arterial highways are still being built. There is hardly a community which has not had an example of a new road on which travel was efficient, pleasant, and safe when it was opened to traffic and which later become inefficient, nerve-racking to the driver, and highly hazardous as roadside businesses came to line the right-of-way. On the other hand there are excellent examples of facilities with full control of access which are as fine in every respect today as they were when opened many years ago.

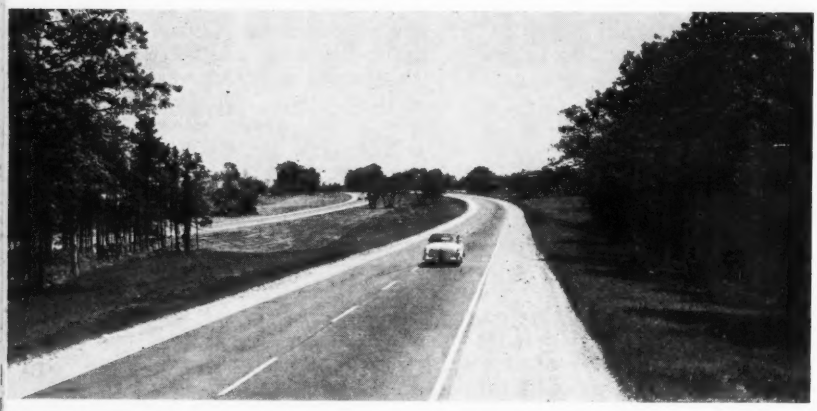
Opposition to access control has stemmed principally from minority interests and from those who are not fully informed regarding the effect of such control. Many communities have resisted the diversion of through traffic from business streets only to find that a controlled-access highway on a new location has actually resulted in increased business on the old roads. The annals of many state agencies, particularly those of the Department of Public Works in California, are replete with such instances. Without access control a relocation is an invitation to new competing businesses to develop alongside, whereas access control retains the values in existing businesses since reduced congestion makes it possible for their true customers to reach them. There is a strong trend toward the development of land adjacent to access-controlled highways with commercial or industrial establishments which do not cater to the passing motorist but which profit by being in proximity to good highway transportation. The study[8] made in connection with the Gulf Freeway out of Houston, Tex., illustrates this point.

Not enough attention has been paid to the long-range economy of control of access. When a highway is constructed on a new location without control of access, particularly in and near urban areas, it soon loses its capacity and the state or other political subdivision is later forced to seek a new location to relieve congestion. In some instances this has happened several times. The states no longer can afford such a policy. Motor-vehicle transportation has grown up and permanent facilities must now be constructed. Facilities with control of access are the only type that can be considered permanent, for with reasonable maintenance and occasional resurfacing they, and they only, retain their full capacity.

Control of access can cost much or little, depending on conditions in individual cases. Where a highway is to be improved on its existing location and the roadsides are well developed with businesses and homes, the cost for acquiring access rights or sufficient right-of-way to construct frontage roads to effect control of access on the through pavements can be very high. Where highways are constructed on new right-of-way, as is likely to be done on a large mileage of the interstate highway system, the cost of acquiring access rights is small and indeed may be nil. Where state laws or judicial authority permit the highway agency to acquire access control without constructing frontage roads, the kind of authority given to toll road agencies, the necessary width of right-of-way is not as great as where frontage roads are to be provided. The cost of the narrower right-of-way, including access rights, usually is less than the cost of the wider right-of-way and construction of frontage roads.

Also, there is a serious question whether adjoining property owners have any rights of access where a highway is constructed on new right-of-way. Already in three states—California, Illinois, and Oregon—judicial decisions have ruled that adjoining property owners have no inherent right of access where such right did not exist prior to the construction of the highway. In such cases the damages are limited to locations where remnants of land are cut off from access to existing public highways. This can be remedied by the purchase of remnants, by the construction of short access roads to existing public highways, or by connecting land

Control of access is strongly recommended for all highways on Interstate System because of its many advantages, including long-range economy and safety. Also recommended is location and design on basis of one-way roadways. Result is both safer and more pleasing when designer thinks in terms of one-way road rather than of one center-line for a fixed cross section. Both these highways meet interstate design standards.



on both sides of the highway by grade separations.

A large item of extra cost on freeways is that of grade separations. These are often provided on non-controlled access highways, but for full access control they are provided at minor crossroads where they might be omitted on highways of less importance. Grade separations at minor crossroads may be deferred when funds are not available at the time of initial construction, but right-of-way for the ultimate development must be acquired or reserved before initial construction, for it is at these grade crossings that roadside businesses develop first and where they interfere most with moving traffic. Even in sparsely settled rural areas, where under some conditions AASHO Standards permit grade crossings in the ultimate design, these factors are recognized by requiring extra corner right-of-way. Such extra right-of-way gives the state a good start toward right-of-way on the crossroad if a grade separation is justified later, and insures that businesses fronting on the crossroad are sufficiently removed from the interstate highway to minimize their adverse effect. In the meantime extra corner sight distance is available for safety.

The wisdom of deferring grade separations on interstate highways is open to question. Drivers on an interstate highway expect complete freedom of movement and are likely to be surprised by crossing vehicles. They will be accustomed to relaxed driving on controlled-access highways, including toll roads, and are not likely to look kindly on interstate highways with grade crossings. That they are willing to pay for highways with full control of access and grade separations is evident from the surprisingly high volumes on most toll roads where, in addition to regular gas taxes, they pay a fee equivalent to about 25 cents a gallon. There is some reason to believe that road users are way ahead of highway administrators.

Even where the cost of access rights and grade separations is high, control of access is still economical if overall costs are considered and not just the cost of the improvement. Overall costs include road-user cost of motor-vehicle operation and maintenance and the value of time, in addition to the annual cost of the investment in the improvement and the cost of road maintenance and operation. A railroad would have a poor accounting system indeed if it considered only the cost of track and ignored the cost of rolling stock and its operation and maintenance. Cost of vehicle operation is less on controlled than on non-controlled access highways with grade crossings, where every stop and delay has a measurable cost. It is not within the scope of this paper to describe the economic analyses of highway improvements. A simple method for making such analyses for comparing alternate improvements is available in a report[9] published by the AASHO.

Accident experience

In making economic analyses for highway improvements, the cost of accidents, though recognized, is usually not included because of uncertain values. Reduction of accidents generally is included with intangible benefits. Where access is controlled, however, the reduction in accidents is so great that the economic saving is significant. There is a sufficient mileage of controlled-access highways in operation to provide a reliable accident rate for comparison with that on highways without control of access. Table IV shows mortality statistics in deaths per 100 million vehicle-miles for all highways on a national basis and for highways with access control. They are taken from National Safety Council data and from data obtained by the agencies operating the controlled access facilities listed.

The mortality experience on toll roads after the first few years of operation is about the same as on other highways with full control of access. Usually when a toll road is first put in operation the mortality rate is high, perhaps because of higher speed than used elsewhere and a lack of familiarity of drivers with behavior conducive to safe operation on such facilities. As adequate enforcement measures are applied and drivers become used to the facility, the accident rate drops. Doubtless the rate on the Turner Turnpike in Oklahoma will decline, the rate shown in Table IV being for operation during the first six months only.

A good measure of the value of access control in reducing accidents can be obtained by comparing experience on parallel highways, since they are used by the same drivers and vehicles as a group, and the general pattern of driver behavior for the area applies to both. Let us examine a few such comparisons.

1. In Virginia, south of Washington, D.C., the Henry G. Shirley Memorial Highway parallels U.S. 1. They are the same length, about 14 miles long, carry about the same volume of mixed traffic [average daily traffic = 10,000 vehicles per day (vpd)] and both are four lanes wide. The Shirley Highway is divided, has 12-ft traffic lanes and 10-ft shoulders, and has full control of access with grade separations, whereas U. S. 1 is undivided, has 10-ft traffic lanes and narrow shoulders, and has no access control. The fatality rates are

TABLE IV. Mortality statistics for all highways and for controlled-access highways

		Fatalities per 100 Million Vehicle-Miles
All highways, national average:		
1941	rural 15.2, urban 8.7, rural and urban combined	12.0
1948	rural 10.9, urban 5.3, rural and urban combined	8.1
1949	rural 10.2, urban 4.6, rural and urban combined	7.5
1950	rural 10.6, urban 4.6, rural and urban combined	7.6
1951	rural 10.5, urban 4.5, rural and urban combined	7.6
1952	rural 9.8, urban 4.5, rural and urban combined	7.3
1953	rural 9.3, urban 4.5, rural and urban combined	7.1
1954	rural and urban combined	6.5

Expressways (controlled access):	Length (Miles)	Av. Daily Traffic	
Va., Shirley Highway, Fairfax County	11.5	11,000	4.3
Conn., Merritt Parkway	37.5	15,000	3.7
Mass., Route 128, Boston Belt	24.6	20,000	2.5
Metropolitan New York systems	...	...	2.5
Calif., Bayshore Freeway	8.5	83,000	2.2
Calif., Hollywood Freeway	5.5	79,000	1.8
Va., Shirley Highway, Arlington County	2.5	32,000	1.7
Texas, Houston Gulf Freeway, city part	9.0	108,000	1.6
Conn., Wilbur Cross Highway	29.5	15,000	1.3
Va., Pentagon Network	8.4	40,000	1.3
Calif., Santa Ana Freeway	11.6	45,000	0.9
D.C., Whitehurst Freeway	0.8	28,000	0.0
Missouri, K.C., Southwest Trafficway	1.2	30,000	0.0
Rhode Island, Olneyville Bypass	3.6	7,000	0.0
Texas, Dallas Central Expressway	3.0	36,000	0.0
Toll expressways:			
Pennsylvania (1954)			4.2
New Jersey (1954)			2.5
Maine (1953)			2.1
Turner, (Oklahoma) (1953)			4.5

TABLE V. Accident experience in relation to control of access, urban and rural areas

Degree of Access Control	Miles in Summary	Rate per 100 Million Vehicle-Miles	
		Accidents	Fatalities
None	899	408	8.0
Partial	849	240	9.6
Full	434	171	2.8

4.2 and 15.9, and the accident rates are 205 and 685 respectively.

2. In Connecticut between the New York State line and New Haven, the Merritt Parkway and U. S. 1 are also parallel facilities, U. S. 1 being located in the vicinity of the shore area of Long Island Sound and the Merritt Parkway several miles inland. They are about 40 miles long and the traffic volume on each is about 15,000 vpd, with passenger vehicles only on the Merritt and mixed traffic on U. S. 1. The cross section of U. S. 1 with its 36- to 40-ft pavement and narrow shoulders, with no access control, is considerably below the standard on the Merritt Parkway, with its 4 lanes each 13 ft wide, a variable grass median of 20-ft average width, and grass shoulders. Statistics (1940-1952) for the Merritt Parkway and U. S. 1 show the fatality rates as 4.1 and 8.1 and the accident rates as 250 and 481, respectively.

3. In Michigan between Detroit and Ypsilanti, the Industrial Expressway and U. S. 112 are somewhat parallel. They are about 24 miles long and traffic volume on each varies from 14,000 to 25,000 vpd. The Detroit Industrial Expressway has control of access with four 11- and 12-ft lanes divided. By contrast, U.S. 112 has no control of access with undivided pavements varying from 40 to 100 ft, with the narrower widths predominating. Statistics (1954) show fatality rates as 2.5 and 4.5 and accident rates as 140 and 495, respectively.

Accident and mortality data on a broader base than the individual highways in Table IV are shown in Table V, which summarizes experience based on reports from several states.

The data leave little doubt that full control of access results in an accident and mortality reduction of one-half to two-thirds. Partial access control shows a similar drop in accidents but actually shows a rise in fatalities. This points to the seriousness of the unexpected. Highways with partial control of access have some protection from the roadsides and some grade separations. Drivers are thus given a sense of security which is false because crossings at grade and side entrances are intermingled with the grade separations. The inevitable conflict between the relatively high-speed through vehicles, and slowly accelerating vehicles crossing from stop-sign positions, results in the serious accidents reflected in the statistics. Full control of access as envisioned ultimately for the interstate system is the important factor in accident and mortality reduction.

Reduction of accidents is no minor item. It stands high in public thinking, and the monetary saving it yields is rather startling in amount. Using National Safety Council figures for 1953, the estimated cost of property damage due to motor-vehicle accidents was $1.6 billion. Adding the cost of loss of wages, $1.3 billion; medical expenses, $1.0 billion; and insurance overhead, $1.3 billion, brings the estimated total to $4.3 billion. This amounts to 0.8 of a cent per vehicle-mile. Since, as has been demonstrated, expressways with control of access have less than half the death and accident rate of the national average, it is conservative to count on a saving due to accident reduction alone of 0.4 cent per vehicle-mile. Assuming a highway with 10,000 vpd, an interest rate of $2^1/_2$ percent, and 40 years for amortization, this reduction justifies an additional expenditure of $367,000 per mile. For 40,000 vehicles per day it amounts to $1,468,000 per mile. These figures do not refer to cost of construction but to the additional cost justified by the reduction in the cost of accidents alone resulting from providing control of access.

Engineering personnel

With the increase in number of motor vehicles and the need for improving our streets and highways to correct existing deficiencies[10] and keep pace with increased traffic demands, there is bound to be pressure for a much larger program of highway development than ever before. Within recent years, several states have each authorized bond issues in excess of $100 million for expenditure on their highway systems in addition to the funds normally available from current tax sources. Massachusetts and Ohio have each authorized $500 million or more.

Increasing financing of arterial routes by toll revenue bonds has added to the annual highway funds available. The President's appeal for a national highway program of a magnitude only dreamed of before, has resulted in thinking at all levels of government that is bound to result in an expanded highway program in one form or another. Considering that other branches of civil engineering are likely also to have increasing responsibilities with the increase in industrial activity, how is this expanded highway program to be handled?

There has been a flood of reports, including a study[11] of technical personnel presented at the January 1955 meeting of the Highway Research Board, indicating a shortage of engineers and the likelihood that the shortage will increase with time. Some may question the reliability of these reports, particularly those for civil engineers, considering the continued low incomes of engineers which cause so many to leave the profession, and also considering that in the past 10 years the largest works program in the history of the country has been completed apparently without any great shortage of engineers. Nevertheless it seems obvious that there will be a strain on the engineering organizations of the state highway departments and other agencies. The strain is likely to be aggravated by the desire to put funds to work as soon as they are authorized. This will make it necessary to keep down the lead time, that is, the time required for planning, traffic surveys, field surveys of alternate locations, preliminary designs, cost estimates, authorizations, and preparation of construction plans, specifications and estimates.

Lead time heretofore experienced by all organizations constructing highways has been too long. The American Road Builders' Association recently reported[12] on lead time for toll roads which included preparation of prospectuses for the sale of bonds to obtain financing. On one toll road about 30 months preceded the 2-year period required for actual construction. Another toll road had a shorter lead time of only 18 months prior to the 2-year construction period. Current practices on federal-aid projects are not much better, for they average about 21 months from the date funds are authorized to the time construction actually starts. With an increase in the availability of funds there is bound to be a demand for decreasing lead time, particularly during the early stages of an expanded program. This will further increase the demand for engineering assistance.

The fact that lead time can be drastically reduced where sufficient engineering personnel is assigned to the task is evidenced by the relatively short time required to design and construct roads of an emergency nature such as those leading to defense facilities. One example is the expressway from the Savannah River Plant of the Atomic Energy Commission to North Augusta. This highway, 19.6 miles long, is a 4-lane divided, heavy-duty expressway with highway and railroad crossings separated. It was opened to traffic less than 7 months after the Atomic Energy Commission wired the South Carolina State Highway Department

that an expressway was needed and funds were being made available. These 7 months included both lead time and construction. The highway was designed and constructed in the customary manner, requiring surveys, preparation of plans, and open competitive bidding. Completion in record time was due to the splendid cooperation and efforts of the South Carolina State Highway Department, which devoted the major part of its engineering personnel to the task.

Standardization and esthetics

With an increased highway program superimposed on a shortage in engineering personnel, a clamor is bound to arise for "more efficient" use of engineering personnel, greater use of subprofessionals and technicians, and standardization in planning, design, and construction. Standardization in many phases of highway development can and should be used to advantage. Many other time savers such as use of photogrammetry should be employed.

The writer, however, is fearful that such a clamor for standardization and speed may result in an interstate highway system of which the nation cannot be proud. Furthermore, too much standardization can result in highways which will be monotonous to the vehicle operator and will have a high accident rate even though their design features, taken individually, are of a high order. Hypnosis caused by driving on long tangents is not an imaginary phenomenon. It is one of the undesirable products of the efficient type of controlled-access highway which results from a design based entirely on standards and lack of attention to important features not covered by standards.

The interstate system is our most important national system of highways. It should excite our imagination, and we should be able to take great pride in it. This result cannot be achieved by standardization and later trimming up with a few bushes and trees. It can come about only through the conscious intent of the designers of each section, who must seek a result which will not only meet the demands of traffic as embodied in the standards, but be pleasing as well. This will not require added cost and need not take added time, as has been demonstrated in the building of fine expressways now in operation.

The Garden State Parkway in New Jersey, which was designed under the general supervision of Harold W. Griffin, M. ASCE, was planned, designed and constructed in as short a time as any other comparable highway facility, yet the result is extremely pleasing, the accident rate is low, and operation on this fully access-controlled highway is relaxing. The design was made by first obtaining aerial photographs and contour maps of the general location by photogrammetric methods and placing thereon a center line for each one-way roadway, coordinating each line with its profile and sight distances. These maps were then turned over to consulting engineers for preparation of the final design, contract plans, specifications, and estimates. Long-tangent, roller-coaster profiles were avoided yet the location is reasonably direct. Sight distance is well above the standard minimum yet is never so great as to encourage unreasonably high speed. The right-of-way is not constant in width but varies considerably so that very wide medians are available in rural areas where land costs were low. Narrow medians and narrow rights-of-way were resorted to in urban areas where land costs were high.

Location and design on the basis of one-way roadways is recommended for all highways on the interstate system. Cars are not driven in two directions at once, and a divided highway is always superior when the designer thinks and works in terms of a one-way road rather than of one center-line for a fixed cross section. The design of intersections and interchanges is not included in this discussion but it is well to mention that designing on the basis of separate one-way roadways is particularly fruitful in intersection design.

Another example is U. S. 240 south of Frederick, Md., a divided highway designed for the Maryland State Roads Commission by the Wilson T. Ballard Company of Baltimore. Here advantage was taken of rolling topography to develop two separate one-way roadways which resulted in grading of about 60,000 cu yd per mile. Studies showed that an alternate with a standard cross section would have required grading of about 280,000 cu yd per mile.

There are many similar examples throughout the country, and there is little doubt that the more pleasing and desirable type of facility results from the design of separate, one-way roadways.

Long tangents are not only detrimental to ease in driving but have another disadvantage from the standpoint of defense, a factor of no inconsiderable importance in the development of the interstate system. In the transportation of military personnel, goods, and equipment, operation on long tangents is vulnerable to strafing from the air, as was proved on the autobahns in Germany during World War II. With the increased speed of military aircraft, the protection afforded by a winding alignment as against long tangents is of even greater significance.

In some sections of the country the topography is such that a sweeping curved alignment will come about naturally, but in other sections avoiding long tangents may result in alignments which will look forced when viewed from high locations. In those states divided into sections there is a strong temptation to follow section lines, since some of the right-of-way already is available, or to follow half-section lines to avoid cutting across farms, which often occupy quarter sections. These difficulties can be overcome by conscious effort in design. There is probably no section in the country where advantage cannot be taken of some detail in the landscape to obtain the desired result. Even in section-line states, there are likely to be some topographic features which disrupt the section-line pattern of farms, and the cost of cattle passes or other minimum grade separations often is justified.

The judgment of road users is based primarily on what they see and on how they can drive. The fact that a highway is efficient and saves time will not long counteract a depressing effect. If drivers see the roadsides cluttered with a conglomeration of businesses and advertising signs, if they have to be continuously on the alert to avoid accidents due to sudden and uncontrolled entrances and crossings, and if they grow weary of the monotonous sameness of long tangents and a fixed cross-section, they will consider interstate highways as just more of the same highways they have always driven. Few will know, and fewer will care, about the toil required to provide adequate roadbed support for all vehicles or about the standardization that insured the meeting of financial deadlines. If, on the other hand, drivers have a sense of relaxation, have an ever-changing view, and drive between roadsides that are pleasing and perhaps green, their sense of security, pleasure, and well-being will develop pride in the nation's most important highway system.

References

[7] "A 10-Year National Highway Program," The President's Advisory Committee on a National Highway Program, 84th Congress, 1st Session, House Document No. 93.

"A Study of Land Values and Land Use Along the Gulf Freeway," Texas State Highway Department, Austin, Tex., 1951.

[9] "Road User Benefit Analyses for Highway Improvements," Committee on Planning and Design Policies, American Association of State Highway Officials.

[10] "Needs of the Highway Systems, 1955–85," 84th Congress, 1st Session, House Document No. 120.

[11] "Technical Personnel Study," by M. Earl Campbell, Highway Research Board, and L. R. Schureman, U.S. Bureau of Public Roads, Department of Commerce.

[12] "The Highway Construction Industry in a Ten-Year National Highway Program." American Road Builders' Association, World Center Building, Washington 6, D.C.

Highlights from June 1955 Report of ASCE Committee on Salaries, composed of Oscar S. Bray, Donald H. Mattern, Graham P. Willoughby, Dewitt C. Greer, Vice Chairman; and Robert J. Ellison, Chairman.

Higher salaries reported for civil engineers

There are two features of special interest in the 1955 Report of the ASCE Committee on Salaries. The first is that there has been a continuing increase in salaries for all the professional grades since the 1953 Report was issued. The second is that in the same two-year period, compensation for those in the higher classifications appears to have increased more, proportionately, than entrance salaries for Grade I.

This 1955 report of the Committee on Salaries is another in the biennial series which carry the title, "Survey of Salaries for Civil Engineering Positions." Data for it were assembled through questionnaires similar to those used for previous surveys, except that three preprofessional classifications—A, B, and C—were included in addition to the nine professional grades. The complete report is available on request as a Proceedings paper, No. 761. Use coupon on page 127. Another survey is scheduled for 1957.

A feature not included in previous reports has been added to determine regional differentials. Median rates for entrance and maximum salaries in each grade are given for five types of organizations according to returns from six regional subdivisions of the country. In general it can be said that civil engineers' salaries are higher in the Far West and South.

A comparison of the salaries of engineer employees with the income of certain labor classifications in the construction industry has also been attempted, although no final conclusion has been possible because of the difficulty of determining the periods between jobs when the trades studied are not working. The findings show that earnings in the building trades average from $5,089 for a 52-week working year to $4,306 for a 44-week working year. In non-building the averages are slightly lower—from about $4,760 for a 52-week year to $4,190 for a 44-week year.

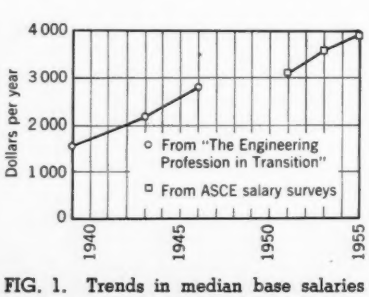


FIG. 1. Trends in median base salaries for entrance in ASCE Grade I.

Salary data deal only with payroll rates, with no allowance for perquisites and no adjustment to correlate data on the basis of a standard number of hours of work per week. However in teaching, where the term is less than 12 months, reported annual salaries have been adjusted upward to the 12-month equivalent on the assumption that vacation income will be at the same rate as the salary during the teaching period.

As in previous years, the survey was conducted on a sampling basis. A simple questionnaire was sent to representative employers of engineers in the following fields: consulting firms; construction firms; railroads, utilities and industries; state highway departments; municipalities and counties; federal agencies; and educational institutions. Altogether, 401 organizations reported on a total of 57,186 individual employees.

The 1953 report recorded the trend in entrance median salaries for the lowest professional grade (ASCE Grade I) from 1939 to date. The same data are reproduced in the 1955 report in a graph with the corresponding figure for 1955 added. It is shown here as Fig. 1.

The 1953 report showed the percentages of increase in the median entrance salary for each of the professional grades during the preceding two years. During that period there had been a 20-percent increase in entrance salaries for Grade I. Moving into the higher grades, the percentages dropped rapidly until at Grade VI there had been no increase. This reflected conditions that were a source of great dissatisfaction among engineer employees.

Returns from the 1955 survey indicate a marked change in this situation. Increases since 1953 averaged 8.2 percent for the entire range of professional grades with extreme limits of 6.5 percent for Grade III and 11.1 percent for Grade VI. This is accepted as gratifying evidence that men with long experience are receiving better recognition than in previous years.

For the 1951 survey, data on "fringe benefits" were obtained and were taken into account in reporting the results of that survey. Only base salaries were included in the 1953 and 1955 surveys. All superimposed compensation such as bonus payments, vacations, sick leave, or other perquisites were not included. Data submitted in the 1951 report indicate that the total value of added perquisites varies between 12 percent and 18 percent of base salaries.

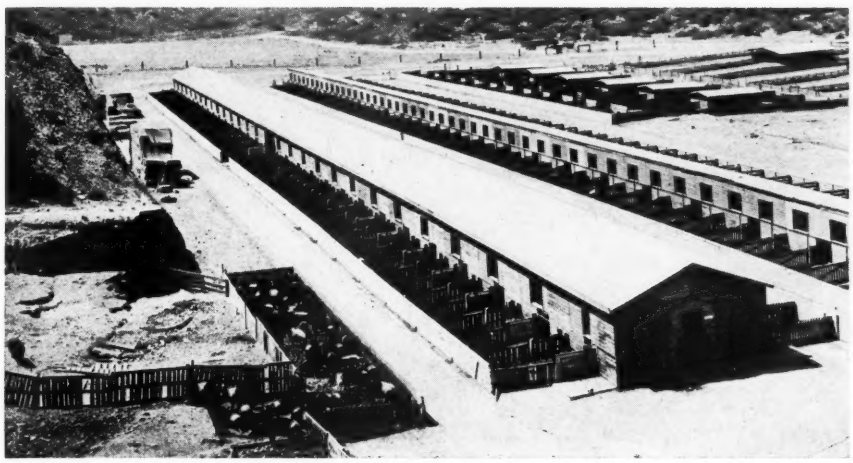
For comparison with the 1953 report (CIVIL ENGINEERING, July 1953, pp. 50–55), a sample category, state highway departments, is given below in simplified form. In 1953, a total of 42 state highway departments reported on 20,996 engineer employees. In 1955, reports came from 38 state highway departments employing 35,785 engineers. Median salaries in the nine professional grades were reported as follows:

GRADES	ENTRANCE RATES		MAXIMUM RATES	
	1953	1955	1953	1955
I	3,180	3,720	4,020	4,540
II	3,744	4,120	4,680	5,070
III	4,428	4,850	5,328	6,060
IV	4,976	5,520	5,820	6,780
V	5,700	6,020	6,720	7,450
VI	6,180	6,990	7,500	8,610
VII	7,200	7,920	8,604	9,490
VIII	8,500	8,730	10,020	10,600
IX	8,500	10,390	9,780	12,250

W. A. SCHNEIDER, A.M. ASCE, Director

Bureau of Sanitation, Department of Public Works
City of Los Angeles, Calif.

In general view of a hog ranch which feeds Los Angeles garbage, brooder unit is in center. Ranch is 40 miles from city.



COOKED GARBAGE

yields dividends to hog feeders

Disposal of raw garbage by hog feeding has been practiced by practically all the municipalities and refuse collection districts in California for many years. This method of disposal in nearly all cases has provided a revenue to the municipality or district involved and thus has certainly proved to be the most economical method available, since all other accepted methods impose an expense for refuse disposal. Further, the feeding of garbage to hogs has the additional advantage of utilizing a resource which might otherwise be wasted. For these reasons public officials charged with waste disposal in California generally have chosen this solution for their garbage disposal problems.

Legislative efforts fail

The other side of the picture is that the feeding of raw garbage to hogs has been the subject of attack in successive sessions of the State Legislature for many years, primarily because of the increase in trichinosis among humans due to improper cooking of pork. Proponents of the prohibitory legislation have been unsuccessful in their efforts, however, and to date no legislation prohibiting the feeding of raw garbage has been enacted in the state of California.

In June 1952 a new factor entered the picture when a swine disease known as vesicular exanthema, which since 1932 had occurred only in California, appeared in Nebraska and then within eight months spread to swine in 38 other states and the District of Columbia. Vesicular exanthema of swine, known as V.E., is a virus disease characterized by blisters on the hooves and mouth. In its external manifestations it is indistinguishable from the dreaded hoof-and-mouth disease. It is endemic to swine and not transmissible to other animals or to humans. It runs a relatively short course and recovery is progressive unless complicated by secondary infections.

Quarantine imposed

In an effort to control this disease, the U. S. Department of Agriculture declared a national emergency and placed a quarantine on all states where known cases of V.E. existed. Packers holding federal contracts were prohibited from buying and processing raw-garbage-fed hogs, and the various states were requested to take the necessary steps to require the cooking of garbage before it was fed to hogs. Although many of the states adopted legislation requiring such cooking, an attempt to pass similar legislation in California during the 1953 session was killed in committee.

The State Department of Agriculture, unsuccessful in obtaining such legislation, then set up a program by which it ultimately attained substantially the same objective through administrative order. In brief, with the consent of the U. S. Department of Agriculture, it issued state quarantine regulations which imposed a permit system controlling the sale and movement of raw-garbage-fed swine. This system required the disinfection of transport equipment and other facilities to a degree which proved onerous to the individual feeders. Tests on the cooking of garbage conducted by representative feeders in former years had shown such

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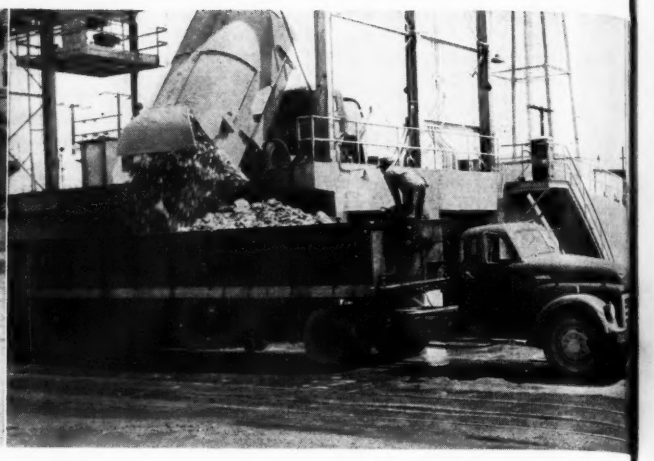

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cooking to be impracticable, according to reports. However the new and onerous quarantine requirements, plus the reduction in the number of packers in the state still buying raw-garbage-fed hogs (now reduced to three), soon brought about a movement among the feeders themselves to investigate more carefully the economics of garbage cooking.

Test results favor cooked garbage

At a hearing held in Los Angeles on July 8, 1954, representatives of three of the larger hog feeders of Southern California submitted a report to the Hearing Board of the State Department of Agriculture which recorded their conclusions after a seven-month test of feeding cooked garbage. The test operation involved 500 hogs, 250 fed on raw garbage and 250 fed on cooked garbage. It demonstrated to the satisfaction of the hog raisers that the feeding of cooked garbage was not only satisfactory but economically advantageous.

The report stated that out of 1,000 swine raised on cooked garbage 76.5 percent could be expected to live to reach the market, as against 53 percent from a similar group raised on raw garbage. This decreased mortality plus the ability to start the young hogs on cooked garbage when they weigh only 20 lb (as against 30 lb when they are fed on raw garbage) resulted in an increase in income of $7,433.50 from the cooked-garbage group.

Other benefits not reflected in this increased income which would in all probability further increase the economic advantage of cooking all garbage fed to swine, were reported to include; (1) cooked-garbage feeders realized 50 percent more pork from a ton of cooked garbage; (2) hog losses from garbage feeding may be reduced almost to zero; (3) swine fed on cooked garbage will bring higher prices in intrastate commerce than those fed on raw garbage; (4) packers report that the "yield" which packers realize from cooked-garbage-fed hogs is much greater than that from raw-garbage-fed hogs, and in many cases is greater than that from grain-fed hogs; and (5) casings from the cooked-garbage-fed animals, according to packers, are much better than those from the raw-garbage-fed hogs.

It was further stated that nearly all the hog feeders in southern California either had installed garbage cooking equipment or had it on order, and that 91 percent of the garbage-fed hogs in the Los Angeles area—consisting of Los Angeles, Ventura, San Bernardino, Orange, and Riverside Counties—would be receiving cooked garbage by August 1, 1954.

At the conclusion of the report it was urged that the quarantine be modified, effective October 1, 1954, to permit any swine ranch which had not had V.E. for 60 days to qualify for release from quarantine after having fed no raw garbage for at least 30 days. No objections to the report or its recommendation were raised by any of the other hog feeders present.

In view of the rosy picture presented in the report, the State Department of Agriculture shortly thereafter issued an order effective October 1, 1954, which released from quarantine those ranches which had discontinued any feeding of raw garbage for at least 30 days and had had no cases of vesicular exanthema for at least 60 days.

Contract adjustments probably unwarranted

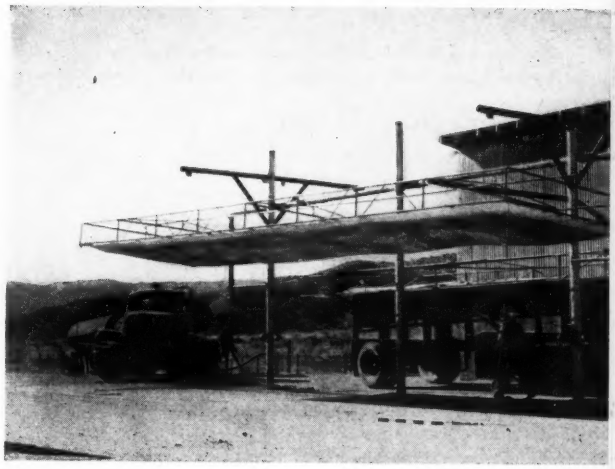
In the past few months several instances have been called to my attention in which municipal garbage disposal contractors have requested contract price adjustments upward, because of the increased cost allegedly incurred in the garbage cooking operation. There are probably opportunists in every field, including hog feeding, and any such request should be considered carefully.

An efficient operator can probably attain all or most of the benefits outlined in the hog feeders own report previously mentioned, and will probably realize a considerable net gain, monetarily and otherwise, from the cooking operation. Many have stated from their experience to date that they would not abandon the cooking of garbage under any circumstances. On the other hand, the less efficient or careless operator who is unwilling to take the time and trouble to secure the benefits available from this method may end up with an overall increase in cost. It appears that, if the interest of the general public is to be protected, any request for contract adjustment should be granted only after a suitable critical review of the hog feeder's operations to determine whether he is following reasonably good business and feeding practices.

Future trend

As to the future, the popularity of garbage disposal by feeding to hogs appears certain to decrease. With decreasing prices being paid by disposal contractors, the higher cost of the separate collection system will still further

Succeeding views beginning at top, left, show how one contractor utilizes Los Angeles garbage and cooks it for hog feeding. City truck picks up garbage (A), and discharges its load into contractor's transport trailer (B) for hauling to hog farm. At hog farm trailer is driven under frame next to steam generating plant (C). After canvas has been drawn down over trailer, steam is turned on (D), cooking garbage. Unloading device is placed on trailer (E), and discharges cooked garbage onto feeding floors (F).



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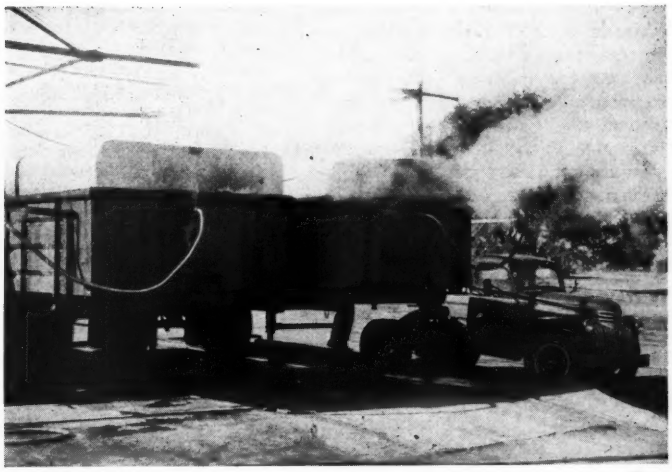
exceed the returns from the sale of the garbage. Many communities now providing separate garbage collection should and undoubtedly will take advantage of the economies to be realized through the collection and disposal of garbage in combination with other refuse.

(This article is based on the panel discussion presented by Mr. Schneider at ASCE's San Diego Convention, before a Sanitary Engineering Division session presided over by R. R. Kennedy, a member of the Division's Executive Committee.)



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Engineering education is every engineer's business

Engineering education has been in process of evolution for many centuries. Concepts of engineering education and ethics expressed by Vitruvius, the Roman, are as sound today as they were twenty centuries ago and have been frequently reiterated in modern times. Unfortunately too little has been done to implement these concepts.

Among recent studies is the "Interim Report of the Committee on Evaluation of Engineering Education," of the American Society of Engineering Education, dated June 15, 1954. This excellent report represents the current thinking of some of the country's foremost engineering educators from all branches of engineering and was offered". . . as indicative of the direction in which engineering education should evolve." This report, in principle, has been recommended as the basis for accreditation of engineering curricula by the Engineers' Council for Professional Development.

Certain general current trends in engineering education are discernible from recent studies and reports:

A. Increasing emphasis on advanced degrees in the selection of engineering teachers.

B. Increasing emphasis on mathematics and basic science.

C. Increasing emphasis on the engineering sciences.

D. Increasing emphasis on the purely scientific approach to engineering problems.

E. In order to retain the four-year undergraduate curriculum, and at the same time increase the number of subjects covered, certain courses are being eliminated and others added.

F. Decreasing emphasis on and gradual reduction or elimination of courses having a high vocational or skill content such as surveying and drafting, and those primarily attempting to teach the art or practice of engineering.

G. Increasing emphasis on the common "core" or "stem" for all engineering curricula and extension thereof, including statics, dynamics, strength of materials, fluid mechanics, thermodynamics, electrical circuits and fields, electronics, heat transfer, engineering materials, and physical metallurgy.

H. Continuing interest in the humanistic-social studies but with little apparent effort to expand the scope of such studies to meet the engineer's needs.

These and other aspects of the total educational process are of concern not only to engineering educators but also to the profession as a whole.

Inadequate secondary education

Formal engineering education starts in the secondary schools. Engineering educators and others express considerable dissatisfaction with high school education, stating that high school graduates are often deficient in English, mathematics and science. Considerable time must be devoted in college to correcting these deficiencies.

No one will deny that the civil engineer of today must have *thorough* training in mathematics, basic science, the engineering sciences, and engineering analysis and design. However, there is real danger that with increasing emphasis on the scientific approach to engineering, the engineer may lose sight of the broader aspects of the problems with which he deals, unless, in the educational process, concurrent efforts are made to instruct in those aspects of engineering which are not susceptible of rigorous analysis. We must not forget that civil engineering, particularly, is still very much an art and must be taught accordingly. The engineering student must be made fully aware of the weaknesses in our present basic knowledge and the important part that judgment must inevitably play in the solution of engineering problems as well as the importance of research.

The larger and more complex the problem or situation in civil engineering, generally the less susceptible it is to systematized analysis and the more the engineer must depend on intuitive concepts and analysis, and on judgment, rather than on methodology; witness a large multipurpose water development project. It is significant that many large industrial concerns are actively attempting to seek out and develop creative ability in employees. We are beginning to realize that such ability is of equal or greater value than managerial or financial ability.

It seems evident that our present concept of the scope and content of studies in the humanistic-social field of engineering education is inadequate for the engineer of today. Not only does the engineer need cultural subjects to broaden his intellectual base and interest, but also he must understand the social, economic, and political forces in our civilization. This is more important to the civil engineer than to the other branches of engineering since much of civil engineering is concerned with public activities. All engineering courses can and should be taught against the broad background of history and contemporary civilization rather than as narrow technical subjects.

In addition, the engineer, during the process of formal education must acquire the basic knowledge necessary to understand, deal with, manage, and direct people. This is an area in

which civil engineers as a group are notably lacking.

The inability to use effectively the ordinary means of communication, written and oral, is generally considered, not without justification, one of the basic reasons why the engineer finds himself in such a relatively poor status, both professionally and economically, and why the fruits of his intellectual labors are so often disregarded. It is imperative that engineering education stress public speaking and report writing.

Graduate study has an important place in the formal educational process and should be encouraged for those students who in their undergraduate work have shown exceptional promise. Unfortunately, both undergraduate and graduate civil engineering students have fewer opportunities for financial assistance than do those majoring in other branches of engineering.

With respect to the selection and qualifications of an engineering faculty, it appears that too much emphasis is being placed on scholarship in the narrow technical sense as evidenced by advanced degrees. A substantial proportion of an engineering faculty should be composed of men of broad experience in engineering and in human affairs outside the field of education. The importance of the quality of the faculty in engineering education cannot be overemphasized.

To attach and hold an adequate faculty will require a salary scale considerably above that now current. In mid 1952, a national survey showed that, after adjustment for the increased cost of living, the salaries of full professors were 12 percent lower than they were in 1941–1942, as contrasted to an increase of 55 percent for industrial workers.

It is believed that it is unwise to eliminate from civil engineering curricula or to greatly minimize those courses primarily attempting to convey engineering art or practices. While it must be conceded that engineering education in the past has placed entirely too much emphasis on such subjects, nevertheless they have an important place in modern engineering education. Over the years many of the courses proposed for elimination have proven their worth, and there is real evidence that elimination of some of these courses in some schools has not benefited the civil engineer. Engineering education cannot be "broadened" merely by eliminating some courses and substituting others.

It must be realized by the employers of civil engineers that graduates from an undergraduate curriculum such as that proposed in the Interim Report would not be competent initially in such practical engineering work as surveying or drafting, the traditional first jobs for young civil engineers. Until the attitude of the profession changes and the necessity and obligation of all employers and supervisors to provide in-service training is widely recognized, the training the student needs for his first job must be considered in planning civil engineering curricula.

Undergraduate instruction must provide the background necessary to enable the engineer to pass the required registration examinations. Recent experience with registration for civil engineers in California indicates that present engineering education may be somewhat inadequate. Close liaison between our engineering schools and the various registration boards is needed.

Four years not sufficient

Four years do not provide sufficient time to cover the necessary subjects in a professional undergraduate curriculum in civil engineering. Five years would seem to be a minimum. Certain universities, the University of Minnesota, for example, have had five-year undergraduate engineering curricula for some years. It appears that there are no insurmountable obstacles to extending the undergraduate curriculum in professional civil engineering to five years although the economic problems involved are serious, both to the student and to the educational institutions.

The civil engineering profession must give thoughtful consideration to the current trends in and the problems of engineering education. On improvement in education rests our professional future.

Employers and supervisors have a very real responsibility for the professional development of young engineers. Such development will obviously react to the employer's interest in the long run, but all too often this is not fully realized.

Employers, both public and private, to the maximum degree possible, should provide in-service training courses, broad in scope and not necessarily confined to technical subjects. Such training in civil engineering has lagged far behind other fields of engineering.

In the larger organizations the trend toward narrow specialization of the engineer must be reversed. Rotation of engineers throughout the organization so as to broaden their experience is highly desirable. Otherwise, the engineer will become only an engineering technician.

Lastly, employers, particularly the larger organizations, should attempt to provide financial assistance to the engineering schools, and to the students, in the form of scholarships, loan funds, and sponsored research projects. The time has arrived when the matter of adequate education for civil engineers can no longer be left solely to committees or educators.

What is needed first is an independent, comprehensive study, objectively made, of the civil engineering profession, of the educational needs therefor, both present and future, and of the adequacy, or inadequacy, of contemporary civil engineering education. A program to provide adequate education for civil engineers both now and in the future, and thereby to enhance the profession, can then be formulated. To find the answers to these questions, we must look far beyond the engineering profession itself, quite possibly to history and the social sciences.

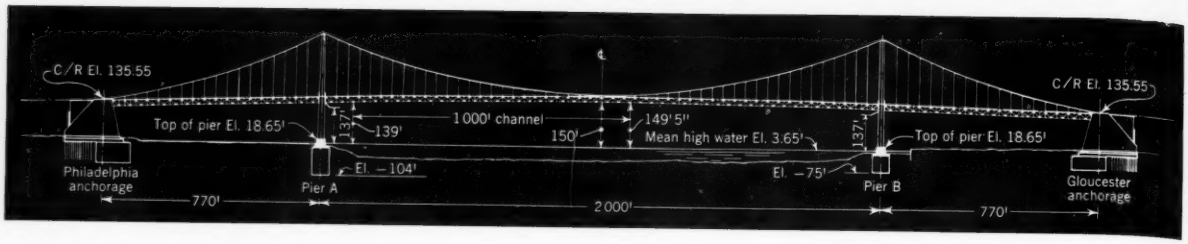
Once the program has been determined, the Society as a whole must insure that it is implemented. Largely as a result of the Flexner Report, which in 1910 brought to light the deficiencies in medical education, the doctors themselves reformed the whole field of medical education and raised their profession to the highest rung on the professional ladder. The legal profession through the Bar Association takes an active part in legal education.

One of the basic problems in engineering education is financial. Funds are needed for increased financial assistance to engineering students, for adequate salaries for engineering faculties, and for improvements and additions to the educational plant. In the solution of this pressing problem, the Society can and must take the initiative. We may look for guidance to the medical profession, which through the American Medical Association, has recently organized the "National Fund for Medical Education" with a goal of $10,000,000 in annual contributions.

The entire Society must be alerted to the problems of engineering education and definite steps taken to insure the future of our profession.

The writer is indebted to his colleagues on the Task Committee on Engineering Education of the Society for many of the ideas expressed here. The reader must not, however, infer that this paper represents conclusions reached by the Committee as a whole, since the Committee has not as yet formulated definite conclusions on certain matters here discussed.

(This article is an abstract of the paper presented by Mr. Banks at the ASCE San Diego Convention, before the General Session sponsored by the Committee on Conditions of Practice and presided over by Mason G. Lockwood, Vice President, Zone IV.)



SAND ISLANDS USED TO SINK CAISSONS

for piers of Philadelphia-Gloucester Bridge

Sand-island method permitted use of much smaller steel cutting edge for caissons and construction with land equipment. Here cutting edge for Pier B caisson is positioned in trench, sections having been welded together in place to form a unit.

WILLIAM L. STONE, JR., A.M. ASCE

Project Engineer, Fehlhaber Corporation, New York, N.Y.

FIG. 1. **Philadelphia-Gloucester suspension bridge across Delaware River has length of 3,540 ft and clear span of 2,000 ft.**

To relieve the overworked Philadelphia-Camden Bridge, and particularly to speed traffic between New Jersey and areas south of Philadelphia, the Delaware River Port Authority is building another Delaware River crossing complete with adequate approaches and feeder highways between Gloucester, N.J., and Packer Avenue in South Philadelphia. Work on this 90-million-dollar bridge and approaches is well under way with nearly all contracts let and completion scheduled for the early part of 1957.

The more than six-mile-long project centers on the 3,540-ft single-span suspension bridge which, with its clear span of 2,000 ft, will be the seventh longest suspension bridge in the world. Main river towers 377 ft high provide 150-ft clearance from mean high water to the under side of the seven-lane bridge. See Fig. 1.

Each component of the project, from the original conception and preliminary studies through the actual design of the various approaches, toll plaza, approach spans and main bridge to the actual construction, is of interest to the engineer. This article, however, deals only with the construction of the two river piers and their foundations.

The piers for the main towers, comprising Contract No. 1, were installed by the Fehlhaber Corporation of New York. Each pier consists of two granite-faced shafts and tie beams resting on a distribution block on top of an open-dredged caisson (Fig. 2). These caissons measured 64 ft 8 in., by 174 ft 0 in. in plan and were founded 108 ft and 78 ft below mean high water.

Although the caissons were originally designed to have their steel cutting edges floated into place and sunk by means of floating equipment, the contractor elected to use the sand-island method instead, since it provides much greater control in positioning the cutting edge and in sinking the caisson. Further advantages were realized from the use of a much smaller steel cutting edge and land equipment.

As the 40-ft-deep navigable channel was only 80 ft from the face of the Philadelphia caisson and the caisson was about 600 ft offshore, a cellular steel sheetpile bulkhead was required for the Philadelphia sand island. The Gloucester caisson was only about 70 ft offshore and was well back from the channel so that wash panels were sufficient to retain the sand island. In both cases the overlying river mud and silt were removed by dredging. On the Philadelphia side the dredging was to El. − 38, leaving silt from El.

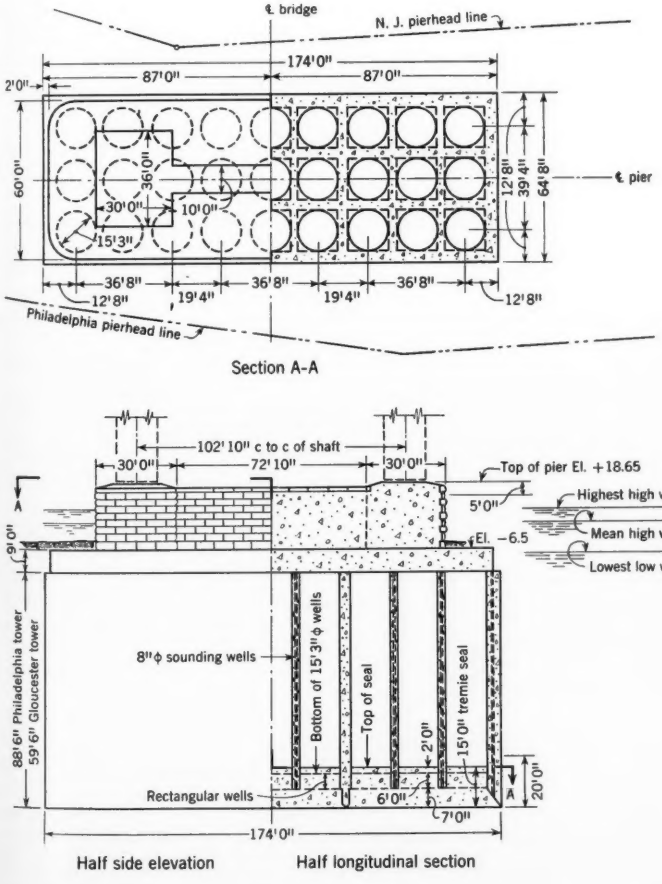
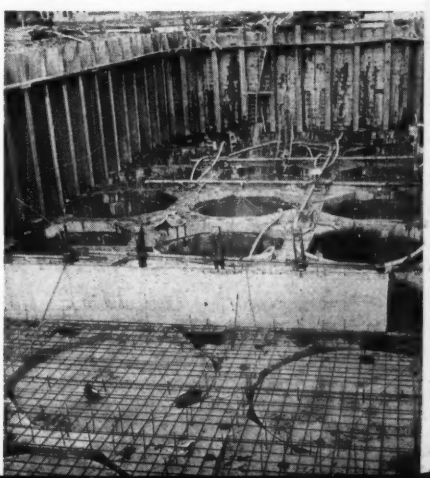


FIG. 2. **For construction of each of two river piers, caisson 64 ft 8 in. by 174 ft 0 in. was founded at depth of 108 ft below mean low water for Gloucester pier and 78 ft below for Philadelphia pier.**

Caisson for Pier A, on Philadelphia side, is seen at founding elevation. Precast concrete covers are in place on dredging wells in foreground and placing of reinforcing for distribution block has been started. In background, bottom cleanup is in progress in preparation for placing of tremie seal. Note piping which supplies rotating jets.



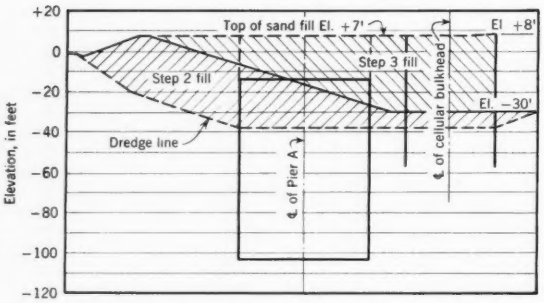


FIG. 3. Sand island for Philadelphia pier (Pier A) was placed in three steps using cellular cofferdam to protect channel, which was 40 ft deep and only 80 ft from edge of caisson. Dredging was Step 1; Steps 2 and 3, involving placement of sand fill, were planned as indicated. However, Step 2 actually was brought up only to El. 0. Step 3 brought entire island up to grade.

− 38 to El. − 42. On the Gloucester side the dredging was to El. − 28, leaving silt to El. − 42. This silt compacted under the subsequent sand and gravel which were pumped from the river bottom to form the islands at El. + 7 ft, and no problem of uneven settlement of the caissons was occasioned by the silt being left in place.

At the Philadelphia pier the sand island was made in three steps to protect the channel (Fig. 3). After dredging, the area of the bulkhead was filled to El. − 30, and the shoreward edge of the island was filled to El. 0, with a 1:3 slope toward the channel. Next the cellular bulkhead was installed. The final step was to fill first the cells to El. + 7 and then the remaining part of the island.

The sheetpile bulkhead was installed by a steam crane on a 250-ft railroad carfloat, from which the center platform had been removed and a plank deck substituted. A similar railroad carfloat provided storage for sheeting and a small barge held the driving template which speeded the positioning of the sheeting. This template consisted of two rings of 45-ft diameter each consisting of 2-in.-diameter pipe spaced 12 ft apart vertically, braced as one unit, and eight 10-in. pipe-pile spuds. This template was removed from a completed cell, placed on the small barge, and the barge moved to the position of the new cell. After accurate aligning of the template, the 10-in. pipe spuds were driven and the template was pinned to the spuds. These operations were done on a falling tide so that the barge could be pulled out from under the template when the latter had been pinned to the spuds.

Six cells, with double connecting diaphragms, were installed. Steel sheetpile wing walls were also installed on the upstream and downstream sides at an angle of approximately 70 deg with the stream flow. The length of the sheeting in the cells and diaphragms varied from 55 to 70 ft. On completion of the bulkhead, the two railroad carfloats were sunk end to end between the sand island and the shore, so as to form a two-lane access road with the addition of three trestle bents—one at the shore end, one between the carfloats, and one at the island end.

To set the steel cutting edge of the caisson, the sand fill was trenched and the bottom of the trench accurately leveled to receive the truck-delivered cutting edge sections, which were welded together in place to form a unit. The bottom elevation of the exterior cutting edge was 1 ft 4 in. lower than the two interior longitudinal, and six of the eight interior lateral cutting walls. The remaining two interior lateral walls were at the same elevation as the exterior, dividing the caisson approximately in thirds, in anticipation of the necessity of cleaning and placing the 15-ft tremie seal in sections because of insufficient skin friction.

Wall forms of various types

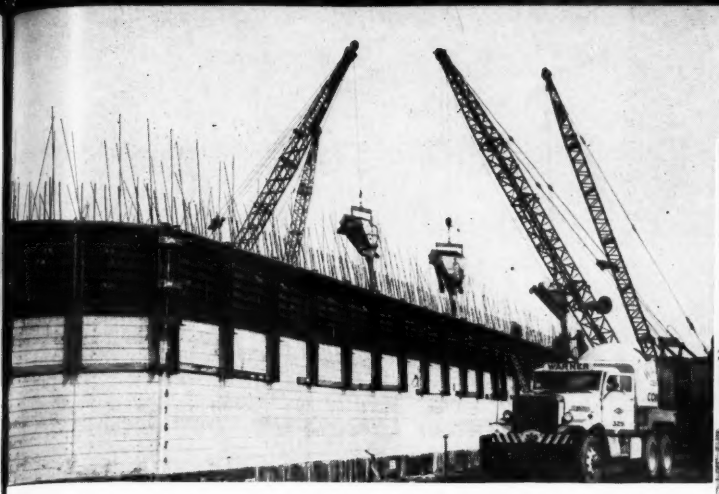
A variety of forms were used for the concrete work. Forms for the exterior walls were Atlas Speed forms, a cantilever pressed-steel channel section permitting a lift of 4 ft 9 in. These were originally designed with the idea of placing the concrete in layers not exceeding 12 in. Considering the large top surface area of concrete involved, it was decided that a more monolithic pour could be secured by placing the entire 4 ft 9 in. in one lift, and the forms were redesigned with a top waler and pencil-rod tie across the caisson. These forms were handled in panels 35 ft long, and could be stripped, raised, and positioned for a new pour in four hours, with one crane and dockbuilding crew. By a slight adaptation, the panels were mated together in height and used for the initial pour of 13 ft by attaching them to the steel cutting edge.

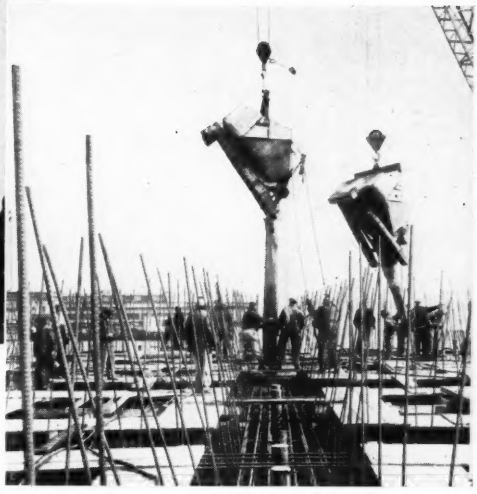
For the rectangular bottom of the dredge wells, conventional wood sheeting and stud panels were used. Above the initial lift, the dredge wells were circular, with a 15-ft 4-in. diameter. The forms used for these wells were simply $^3/_{16}$-in. × 5-ft 0-in. steel plate rolled into a cylinder. The ends of the plate overlapped so that the circle could be collapsed for stripping. Because of trucking limitations these cylinders were fabricated in three segments and job assembled. Three screw anchors were set near the top of each pour for each dredge well. The cylindrical form was then collapsed, raised, set on a bracket fastened at each screw anchor, and expanded. Proper alignment was achieved by the overlap of concrete at the bottom and by means of the pencil-rod ties of the exterior forms. Each form carried its own plank platform, which served as the working area for each lift and was so attached as not to interfere with placing or stripping. A refinement developed on the job was an attachment like umbrella ribs placed within the drum so that a snap-over center action, induced in picking up the drum, collapsed it automatically. The 27 drums, like the side-wall forms, could be stripped, raised, and positioned by one crane and dockbuilding crew in four hours.

Sounding wells of 8-in. diameter were placed throughout both exterior and interior walls. The initial 8-in. steel pipe was welded into the steel cutting edge.

Sinking of the caisson was carefully coordinated with concreting to achieve a maximum number of lifts of concrete per cycle for economy in time and expense consistent with the safety of the caisson. Dredging was carried out on a multishift basis through the sand fill, the underlying sands, gravels, and clays using clamshell buckets and cranes. To facilitate the movement of the caisson through the sand, a built-in jetting system was used to break the skin friction. Once the caisson was in the clays, its relative weight could be increased by pumping down the water within the dredge wells. Connecting equalizer openings through the walls between wells, near the bottom of the wells, aided in this pumping, which at times brought the water 30 ft below the river level.

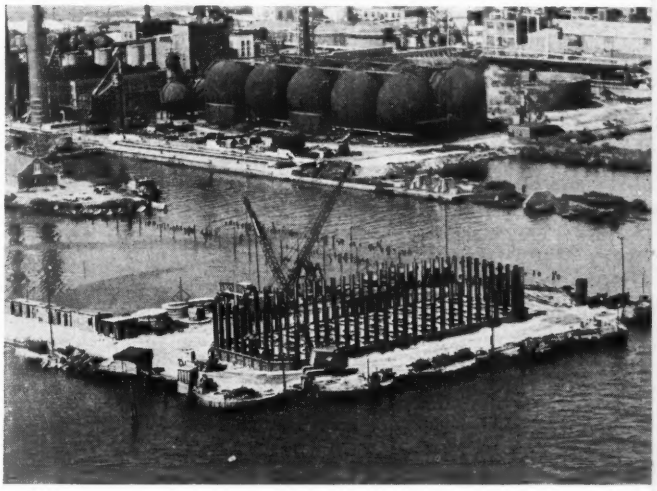
Tolerances in the position of the caisson after founding were specified as 12 in. in any direction and 12 in. in level. The caissons were actually landed well within these limits. Interesting to note was the decision of the contractor to set the cutting edge of the





Second lift is placed in caisson for Pier A, on Philadelphia side. Exterior wall forms, seen in above view, consist of cantilever pressed-steel channel sections. View at right shows reinforcing for caisson and working platforms in place over dredging wells. Note also rubber concrete pipes attached to buckets to eliminate hoppers.

Caisson on Philadelphia side is ready for last lift of concrete. Soldier beams for cofferdam are in place. Air view also shows precast concrete covers for dredging wells piled up to left of caisson. Two-lane construction road to shore, formed by sunken dredges and connecting trestle bents, runs out of photo at left.

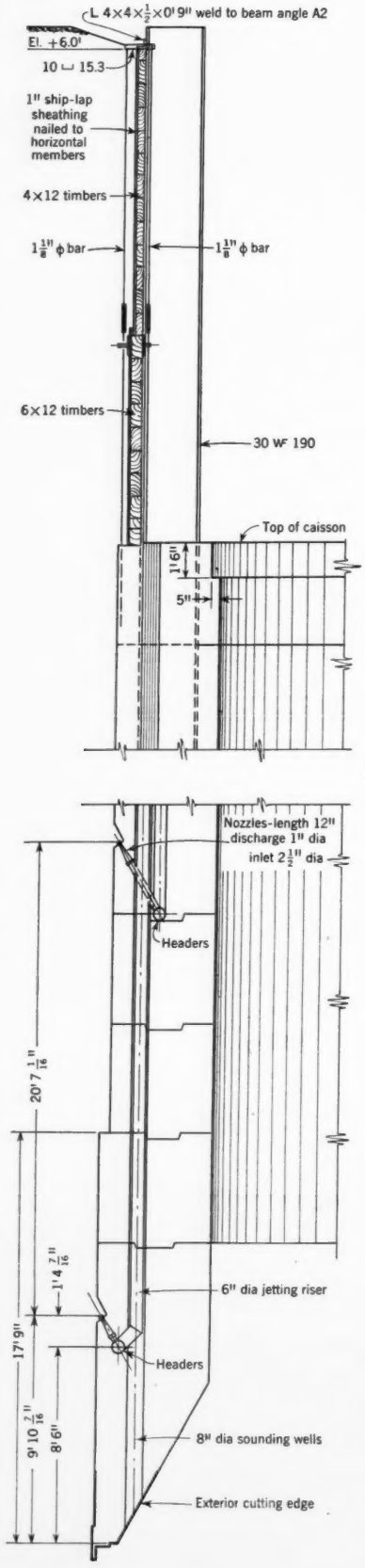


Philadelphia caisson 3 in. inshore of the plan, believing that any movement of the sand island or bulkhead wall would take the caisson riverward. However, the anticipated movement did not occur and the caisson landed in about the same position, or 3 in. inshore.

Both caissons were founded very close to their design elevations—the Philadelphia caisson at El. −104.83 and the Gloucester caisson at El. −74.13 as compared to their approximate design elevations of −104 and −75 respectively. Actually the cutting edges were slightly higher than these elevations and the tremie seals extended to the founding elevations.

Cleanup of the bottom and tremieing were done over about one-third the bottom area at a time, as designed. High-velocity, high-volume rotating jets cut away the clayey material under the caisson above the cutting edge. As this material was washed to the dredge well, the clamshell buckets removed it. The remaining sludge, which contained 50 percent solids in some cases, was removed from all wells by means of an air lift. Divers directed the operation of this air lift and made a final inspection of the bottom, after which the tremie seal was placed through pipes of 12-in. diameter. The impervious nature of the stratum of material at the bottom allowed the water level in the cofferdam to be lowered sufficiently to

Granite-faced pier is being erected inside cofferdam on Gloucester side. Dredge in background is supplying fill for another contract of the project.



allow all concrete to be chuted to hoppers at the top of the tremie pipes without danger of producing a leak through the tremie seal because of the difference in hydrostatic head caused by the pumpdown. The tremie seal was brought up in each dredge well for a height of 15 ft above the cutting edge.

Since the top of the caisson was to be approximately at El. −15.5, a 22-ft-deep cofferdam was necessary for the construction of distribution blocks, pier shafts, and tie beams up to the grade of the sand island. This cofferdam was attached to the caisson and the caisson pulled the cofferdam down with it as it sank. The many dredge wells, sounding wells, and work on the beams and shafts indicated that any interior bracing of the cofferdam would have to be shifted many times during the final sinking and subsequent work. The cost of any interior bracing and its shifting could therefore be balanced against a vertical cantilever soldierbeam system with all bracing eliminated. The soldier beams chosen were 30 WF 190 sections and afforded an excellent method of attaching the cofferdam to the caisson, being embedded in the two top lifts of the caisson to resist cantilever action. Embedment was accomplished by boxing out for the soldier beams in the next to the top lift, setting these beams and concreting them in the boxes, and then concreting the top lift. Extra reinforcing steel was provided around the soldier beams in these two lifts.

Sheathing of the cofferdam consisted of large panels of horizontal 6 × 12 timbers for the lower 9 ft, and 4 × 12 timbers for the remainder. These were placed to bear against the outer flanges of the soldier beams and were restrained horizontally by bolts to the soldiers, and vertically by clip angles on the soldiers and tie-down rods between soldiers. See Fig. 4. The tie-down rods were in two sections, holding the top panel and the bottom panel separately. Matching the size of the cofferdam with the size of the distribution block allowed the use of the bottom panel as the outside concrete form of the distribution block. On completion of the work within the cofferdam, the tie-down rods for the 4 × 12 upper panels were released and the top panels removed. The 6 × 12 lower panels were left in place. The soldier beams were removed above the distribution block, except for those soldiers on the river side and parts of the ends of the cofferdam that were retained by the Authority for the framing of the permanent fender system, which was redesigned to take advantage of these soldiers.

FIG. 4. Timber cofferdam with soldier beams is secured to top of caisson. Cofferdam 22 ft high consists of soldier beams about 31 ft long, with horizontal sheeting of 6 × 12 timbers for bottom 9 ft and 4 × 12 timbers for upper 13 ft. On outside, 1-in. vertical ship-lap sheathing reduces drag on cofferdam panels and increases watertightness. Lower headers were used on both caissons, upper headers on caisson for Pier A only.

To reduce the drag of the cofferdam panels and to increase water-tightness, 1-in. vertical ship-lap sheathing was applied to the outside face. This, together with precautions at the junction of the panels with the caisson, and at the junction of panel to panel, produced an amazingly dry cofferdam. A 2-in. pump was more than sufficient to remove leakage from the 62 × 172 × 22-ft cofferdam.

Before concreting the distribution block the dredge wells of 15-ft 3-in. diameter had to be covered. Reinforced concrete "pie plates," 16 ft 0 in. in diameter and 12 in. thick, were precast during the concreting of the various caisson lifts and were set into an octagonal seat 1 ft 6 in. deep, cast into the top lift of each dredge well. The difference between the depth of the seat and the "pie plate" provided a recess 6 in. deep at each dredge well, to key the distribution block to the caisson.

Pier shafts and tie beams were brought up in lifts by placing the granite facing and backing up with concrete. Bearing-plate elevation is at + 18.82 ft after grinding. Each bearing area (two areas for each pier) was 17 ft 6 in. × 23 ft 6 in. Grinders and terrazzo machines ran on a special support and frame which gave control for the specified tolerance, allowing no projections above the bearing elevation and no depression more than $^1/_{16}$ in.

The entire 6-mile project is being promoted and financed by the Delaware River Port Authority, an interstate agency of New Jersey and Pennsylvania, composed of eight Commissioners from each state. Joseph K. Costello is Executive Director of the Authority and Daniel M. Kramer is Chief Engineer. Modjeski & Masters–Ammann & Whitney are the engineers for the Authority, with Homer R. Seely, M.ASCE, as Project Engineer. Moran, Proctor, Mueser & Rutledge were consultants for the Fehlhaber Corporation. Fehlhaber personnel were Charles Rauterkus and Aaron Burros, superintendents, S. Jay Winterberg, M.ASCE, Chief Engineer, and William L. Stone, Jr., A.M.ASCE, Project Engineer.

ENGINEERS' NOTEBOOK

POLARISCOPE—*pride of structures laboratory*

R. L. SANKS, A.M. ASCE

Assistant Professor of Civil Engineering, University of Utah, Salt Lake City

Featured attraction of the Civil Engineering Structures Laboratory at the University of Utah is its polariscope, although the laboratory is unusually well equipped in other ways for experimental stress analysis. Influence lines for rigid frames and trusses are obtained with Beggs, Eney, or wire-model deformeters. Whittemore strain gages, Huggenberger tensometers, dial gages, SR-4 gages, and Stresscoat are used to study models or full-sized structures. Precision strain indicators and oscillographs, bridge amplifiers, and oscillograph cameras measure static or dynamic strains. Portable, multiple-channel dynamic strain-recording equipment and modern testing machines are also available.

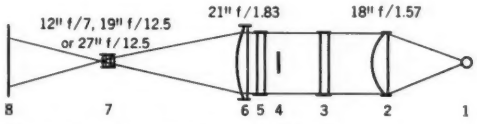
The photograph shows the remarkably large, versatile polariscope, 15 ft long, with a clear field $11^1/_2$ in. in diameter. Lenses are quickly interchanged by removing one capsan nut. The camera lens (No. 7) is a Bausch & Lomb Convertible Protar VII*a* f/7 with a Betax shutter. Its focal lengths are 12, 19, and 27 in.

Orientation of the field lenses (Nos. 2 and 6) is shown in Fig. 1. The "f" numbers are focal lengths divided by the effective aperture of $11^1/_2$ in. All are Bausch & Lomb plano-convex lenses, two being inexpensive enlarging condenser lenses (Catalogue 51-71-18 and 51-71-21). With this system expensive strain-free lenses are not required. The field is exceptionally brilliant; even with filters in place, the light source must be stopped down to take exposures as long as 1 sec.

The polarizer and analyzer (Nos. 3 and 5) are connected by selsyn motors to keep the axes always crossed. Backlash is less than 0.1 deg. Each $13^1/_2$-in. main bearing consists of 32 balls in V-shaped races. Two inch-ounces of torque rotates both units. Quarter-wave plates are instantly removable.

The white-light source (No. 1) is a T-5 200-watt projection lamp. In

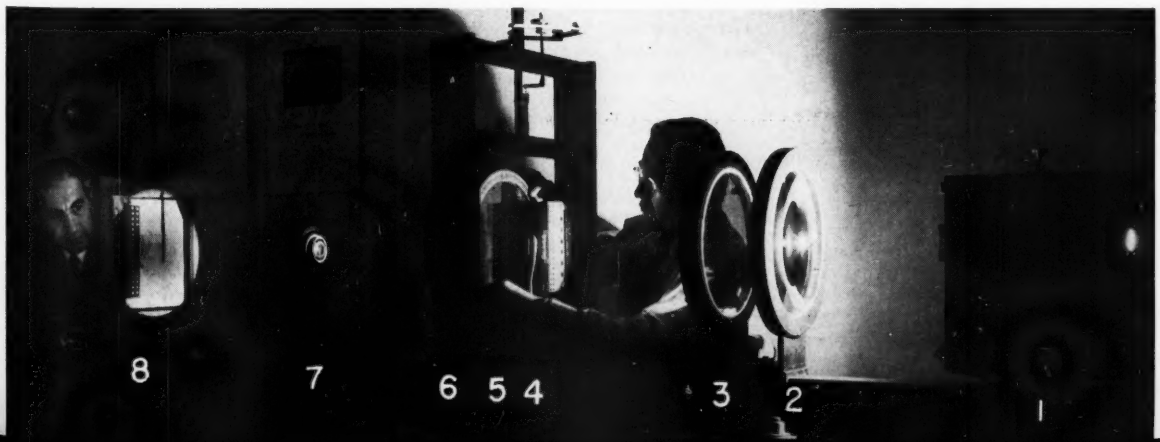
FIG. 1. Orientation of field lenses (Nos. 2 and 6) yields distortionless, flat field of 7-in. diameter in (*a*), and of $11^1/_2$-in. diameter in (*b*).



(*a*) Lens arrangement for small models, magnification 0.67X to 5X

(*b*) Lens arrangement for large models, magnification 0.22X to 0.64X

Polariscope is arranged for study of stress pattern in model of stub shaft, in transmission of EIMCO Model 105 tractor, by Chief Engineer D. M. Schwartz (left), as author adjusts quarter-wave plate. (1) Light source, (2) field lens, (3) polarizer, (4) model, (5) analyzer, (6) field lens (hidden), (7) camera lens, (8) tracing frame (or camera).



the same housing is a Hanovia AH-4 mercury arc lamp. The 5461 A degree line is nicely separated by a 4-102 Corning glass filter in a lens shade attached to the camera lens. Recently a diffused-light source consisting of 6 green fluorescent tubes behind a ground glass was added. No field lenses are used with the diffused light, which, although inferior to the mercury arc, has certain advantages for the study of gelatin models and for photographing slices of three-dimensional models. Future plans include a water-cooled 1,000-w mercury arc lamp for the study of three-dimensional models using Weller's scattered-light technique.

Most of the machining and other work was contributed by the following local firms: American Smelting & Refining, Monsey Iron & Metal, Tintic Mining Co., Hal Rummel, State Brass Foundry, Fuller Paint Co., and Rex Industries. The polarizer and analyzer units were built under contract by Werner Ruefenacht. The University thus obtained a polariscope worth about $5,000 for half that sum.

Several features of the plans were developed from excellent polariscopes designed by Prof. H. D. Eberhart, A.M. ASCE, University of California, and Don Horning, Consolidated Vultee Aircraft Corp. Many others, including Dr. Franklin S. Harris Jr., Roscoe Wooley, and P. J. Elsey contributed ideas. Department Head A. Diefendorf, M.ASCE, made the laboratory facilities possible.

Method presented for computing steel prestress losses

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Steel stress losses in prestressed concrete due to creep, shrinkage and plastic flow are among the most controversial points in prestressed concrete design. Since there are so many different prestressing systems and so many variables for the materials being used, it is very important that an accurate general method for computing stress losses be adopted. Research on this subject is being conducted for the Texas Highway Department by the Texas Engineering Experiment Station. The opinions expressed here are to be considered those of the authors and do not necessarily reflect the views of the Department.

Stress loss in steel can be attributed almost completely to four distinct causes: (1) Creep or relaxation in the stressing steel, (2) shrinkage in the concrete, (3) instantaneous or elastic strain in the concrete on application of the prestress, and (4) deferred strain (plastic flow and creep) of the concrete in compression. These factors emphasize the fact that the total strain in the concrete is the major consideration.

Loss in prestress can be accurately estimated by substituting correct values in the following formula:

$$\Delta f_s = (u_s + u_e + u_d)\, E_s + k f_{si} \quad . . (1)$$

in which

Δf_s = total unit stress loss in stressing steel

u_s = unit strain in concrete due to shrinkage

u_e = unit strain in concrete due to elastic deformation

u_d = unit strain in concrete due to deferred deformation (plastic flow and creep)

E_s = modulus of elasticity of steel

$_{si}$ = initial unit prestress in stressing steel

k = percentage of stress loss for particular steel used, based on "creep" curve of steel

The unit strain values should be computed at the center of gravity of the stressing steel, and the average strain values from end to end of the stressing element should be used. A considerable amount of research work needs to be done to evaluate the various terms accurately but the method presented here will enable the designer to keep his guesswork to a minimum and on a rational basis.

Various engineers and organizations over the country are now allowing maximum initial steel stresses varying from 0.6 to 0.8 of the ultimate strength of the steel with maximum final working stresses, after deduction of all losses, varying from 0.5 to 0.6 of the ultimate strength of the steel. The higher values are desirable from the standpoint of efficient use of the material. However, in post-tensioned construction the most common practice is to make a flat allowance of 15 percent of the initial steel stress to take care of all stress losses. This is incorrect and the following brief discussion of the factors affecting the stress loss should point out the necessity for each of the terms in Eq. 1.

Creep or relaxation in the steel

Normally "creep" is the term applied to the elongation of a steel specimen subjected to a constant load, and "relaxation" is the stress loss in a loaded

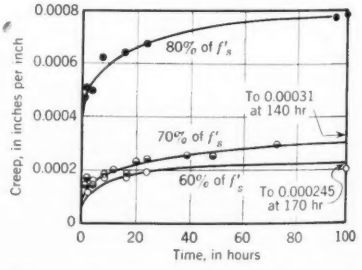


FIG. 1. Creep of high-strength wire is plotted at various stress levels. Reproduced by permission from "Creep and Relaxation of High-Strength Steel Wires at Room Temperature," by Gordon T. Spare, *Wire and Wire Products*, October 1952.

specimen with a constant length. The test curves are practically identical, and no confusion is intended where the terms are used interchangeably in discussing prestressed concrete.

Creep will vary for any particular steel stressed to different fractions of the ultimate strength. For example, Fig. 1 shows the results of tests run on wire of 0.192-in. diameter with an ultimate strength of 250,000 psi containing 0.80 percent carbon, 0.58 percent manganese and 0.21 percent silicon. The creep at 100 hours in this case is approximately $3\frac{1}{2}$ times as much when stressed to 80 percent of the ultimate as when stressed to 60 percent of the ultimate.

Creep or relaxation in a particular steel is a function of the unit stress in the steel but it will vary for different steels stressed to the same fraction of the ultimate strength. Whether the steel is stress relieved, and how it is stress relieved, have a great effect on this phenomenon. In the stress range of 50 to 60 percent of the ultimate strength, many of the hard-drawn wires will creep an appreciable amount, but the same wire stress-relieved by pulling through molten lead around 800 deg F will show practically no creep at all. On the other hand, the stress-relieved wire will creep a great deal more than the hard-drawn wire in stress ranges of 70 to 80 percent of the ultimate.

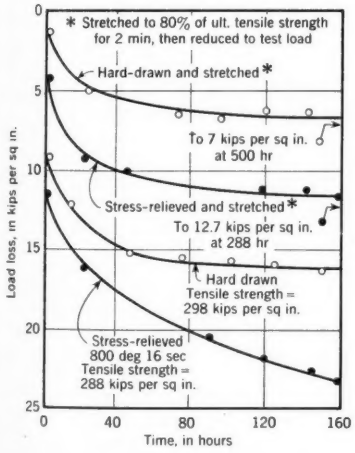


FIG. 2. Curves show typical results of relaxation tests on high-carbon wire of 0.080-in. diameter, both hard-drawn and stress-relieved, from initial load of 70 percent of f'_s (ultimate tensile strength). Reproduced by permission from "Steel Wire for Prestressed Concrete—Discussion," by W. O. Everling, Proceedings of First U.S. Conference on Prestressed Concrete, M.I.T., Cambridge, Mass., August 1951.

The performance of non-stress-relieved wires, some stress-relieved wires and many of the stranded cables used for prestressing concrete can be greatly improved by overstretching in the stressing operation. Stressing the steel to 80 to 85 percent of the ultimate, holding the stress for 2 or 3 minutes and releasing it, then restressing to 70 percent of the ultimate will reduce the creep at the 70 percent level by as much as one-half in most cases. Overstretching actually work-hardens the steel, and this practice has been rather widely used, but the very nature of most existing specifications does not allow the designer to take advantage of the reduction in stress relaxation.

Many authorities in the field of prestressed concrete have expressed the opinion that over-stretching does very little good. This is only true when the steel is stressed to 0.6 or less of the ultimate; but at initial stress levels of 0.7 to 0.8 of the ultimate, overstretching of many of the steels is very necessary if excessive creep is to be avoided. Under such high stresses the steel will relax as much as the total allowance now being made for creep, shrinkage and plastic flow on many unstretched steels.

Typical results of relaxation tests for a high-carbon wire of 0.080-in. diameter, both hard drawn and stress relieved, are given in Fig. 2. The same data are given for the wire after it has been overstretched to 0.8 of the ultimate. All four curves are drawn for a stress level of 0.7 of the ultimate.

The curves presented here are typical of one product and are given for demonstration purposes only. Each steel product will have its own characteristics, and obviously the allowance for stress loss due to creep in the steel should not be the same for every case. It is believed that the steel manufacturers are in a position to furnish reliable laboratory data concerning the "creep" characteristics of their respective products at little or no expense to the designer.

Shrinkage in concrete

Shrinkage in the concrete (u_s) is highly variable, but some of the variables can be controlled by the engineer. The most important factors are climatic conditions, amount of water in the concrete, and amount of fines (inert grains passing the 200-mesh sieve) in the concrete. Excess water and excess fines result in excessive shrinkage. Dr. Fritz Leonhardt of Stuttgart, Germany, recommends values of 0.0003 in. per in. for shrinkage in dry climates and 0.0002 in. per in. in moist climates. (See "Tensioning Materials and Anchorages Used in Prestressed Concrete Construction," Curzon Dobell, *Proceedings of Western Conference on Prestressed Concrete*, p. 18, University of California, Los Angeles, Calif., November 1952.) The 1953 AASHO specifications (page 181) dealing with concrete not subject to prestress, give a value of 0.0004 in. per in. for shrinkage and make no stipulation regarding the factors affecting it. Normally one-third to one-half of the total shrinkage will occur within the first 10 days using normal Type I portland cement.

Elastic strain in concrete

The instantaneous or elastic strain (u_e) in the concrete due to the prestressing load is a function of the unit stress in the concrete and may be computed as $u_e = f_{ci}/E_c$, where f_{ci} is the initial unit stress in the concrete and E_c is the modulus of elasticity of the concrete at the time the prestress is applied. The value of u_e is not constant over the cross section or throughout the length of the beam. Computations should be made at the center of gravity of the steel, and the average unit strain from end to end of the member should be used in computing the stress loss.

Deferred strain in concrete

The deferred strain (u_d) in the concrete will also vary a great deal. The term "deferred strain" is used here to avoid quibbling over the definitions of "plastic flow" and "creep," but for the purpose of this paper they may be used interchangeably. The magnitude of the deferred strain will be affected by such things as volume of cement paste, water-cement ratio, and method of curing. Since an increase in cement content is usually accompanied by an increase in volume of water, extremely rich mixes are generally undesirable. The shrinkage and creep can be kept to a minimum by keeping the volume of cement paste, the volume of mixing water, and the water-cement ratio to a minimum consistent with desirable consistency and workability. Dr. Leonhardt recommends a deferred strain value of 2.5 times the elastic shortening in dry climates and 2.0 times the elastic shortening in moist climates. Deferred strains as great as 3.0 times the elastic shortening have been reported.

Conclusions

By adopting a general formula in design specifications and construction procedures, such as the one given above, the designing engineer will be able to properly evaluate each design and effect savings by controlling some of the factors affecting the steel stress loss.

Unless an engineer has better information available for a specific case, the following values for heavy concrete will normally be suitable for use in Eq. 1:

FACTOR	PRETENSIONED	POST-TENSIONED
u_s =	0.0002 in. per in.	0.0001 in. per in.
u_e =	f_{ci}/E_c	0 (elastic strain will occur before steel is anchored)
u_d =	$2.25\,u_e$	$2.25 f_{ci}/E_c$

In both cases, k and E_s should be determined by "creep" curves and stress-strain curves for the specific steel being used. For most high-strength steels stressed to 70 percent of the ultimate, the value of k will not exceed 8 percent of the initial prestress, and if over-stretching is practiced, the creep or relaxation will not exceed 4 percent. Values of k for initial stresses up to 80 percent of the ultimate will be considerably higher.

Normally the engineer tries to prepare his plans and specifications in such a way that any qualified bidder can compete fairly. Since it is impractical to prepare a complete set of plans for every prestressing system, the question arises as to how one set of plans can be made to suffice with fairness to all. The engineer can prepare his plans and specifications stating the final total prestress with a statement as to the allowable final unit stress, such as 0.6 of the ultimate, and stipulate that the allowance for stress loss will be computed in accordance with Eq. 1.

THE READERS WRITE

Young graduates often blind to advantages of private practice

TO THE EDITOR: With many other engineers in private practice, I was much interested in what Prof. Sumner B. Irish wrote regarding recruiting of civil engineers for consulting offices in your June issue, page 63. Perhaps he and others would be interested in the experience of our firm.

We have given up visiting engineering colleges to recruit possible new employees for our office. We have learned that the great majority of civil engineering graduates are firmly convinced their best future lies with industrial firms, and that it is most difficult to persuade them to the contrary. We feel that initial salary and early advancement are better for the engineering graduate with industrial firms than with firms in private practice, and necessarily so because engineers in private practice cannot afford to devote very much of their operating funds to the training of young engineers, whereas that type of expense can easily be assumed by many industrial firms.

Personally, I feel that the young engineer will find that better compensation has a way of flattening out after five to ten years with an industrial firm for most engineers who enter such work. With firms in private practice the compensation for able men after five to ten years, in my opinion, is much higher than with industrial firms.

We have adopted the practice of recruiting new men for our office by using well-worded advertisements in good technical publications, like CIVIL ENGINEERING, and by passing word around among our friends and acquaintances to the effect that we have vacancies for qualified men with five to six years of experience subsequent to graduation from a good engineering school.

We have employed some young graduates and are not adverse to doing so now, but I cannot forget a recent experience when I traveled some 1,100 miles from Chicago to interview 20 pending graduates, spent an entire day on that task, and did not succeed in getting one single new employee for our firm. All the men I interviewed had visions of becoming president of some industrial firm at a salary of $50,000 a year or more.

Need I remind any young engineer who happens to read this letter that the engineer in private practice develops a wonderful sense of independence and professional pride which may be lacking in the salaried staff engineers of a large corporation?

Need I remind him also that opportunities for becoming a principal in private practice are much better for the young engineer who joins a consulting firm than for the man who follows the route of work in industry?

ARTHUR W. CONSOER
Consoer, Townsend and Associates
Consulting Engineers

Chicago, Ill., and Pittsburgh, Pa.

World needs in sanitary engineering

TO THE EDITOR: The article, "World Health—Sanitary Engineering Can Make a Great Contribution," by Frank M. Stead, M. ASCE, in the April issue, pleased me greatly. Some of the findings he brings out in the matter of adapting Western engineering knowledge to the culture of the people are most relevant. In my four years of experience as the first sanitary engineer appointed by the Division of World Missions of the Methodist Church to work in India I have found and am finding day by day how important it is to know the people and their cultural background.

Of course the need to keep up continually with current research can never be lost sight of, and in undeveloped parts of the world, it may be necessary for the engineer to do a considerable amount of research himself in an effort to provide engineering solutions meeting the demands of economy and culture.

A profession is a calling and a calling is fulfilling a need greater than one's own. It is hoped that more and more sanitary engineers will realize the responsibility of our profession to meet the great needs existing in the world today beyond our backyard fence.

KAZ KAWATA, J.M. ASCE
Sanitary Engineer

Jullundur City
East Punjab, India

Can design be based on ultimate strength?

TO THE EDITOR: The discussions of our article, "Can Design Be Based on Ultimate Strength?" (January issue, p. 59), focus attention on several points that should be considered. In Mr. Jones' letter (March issue, p. 64) the question is raised as to the economic advantage of using plastic analysis over current AISC specification provisions (Section 15-3) which allow a 20 percent increase in allowable stress over an interior support. Mr. Wiesinger (March issue, p. 64) brings up a most interesting topic—the question of a prorated factor of safety based on degree of uncertainty for different types of loads. Mr. O'Leary (April issue, p. 63) lists several possible limitations on plastic analysis.

Commenting on Mr. Jones' letter, it should first be reemphasized that plastic analysis is a method of solution based on actual ultimate strength. For design by this method then, the given loads are stepped up by a given load factor of safety (margin of desired load capacity above the working load), and required member sizes

are determined which are capable of supporting these stepped-up loads at or below their ultimate strength. The actual selection of this load factor is arbitrary at the present time, not having been established by code. For comparative purposes it was decided that the criterion for its selection might properly be the ultimate load capacity of a simple beam divided by the working load according to the present AISC specification. As demonstrated in the original article, this value is equal to 1.88.

In the continuous beam example presented by the authors, maximum elastic moment occurred within the span. Comparative designs showed that the plastic analysis solution using a load factor of 1.88 resulted in a more economical choice of members than did the one based on the current AISC specification. However, in Mr. Jones' example, with the loads located so that the maximum elastic moment occurred over the interior support, for which the specification allows a 20 percent increase in allowable stress, the plastic analysis solution was slightly more conservative. The following conclusions can be drawn: (1) designs based on the present AISC specification have a variable factor of safety against ultimate carrying capacity, and (2) under certain circumstances these specifications allow the design of a continuous member having a slightly lower load factor of safety than for a simple beam (1.88).

So that there will be no misunderstanding, it should here be pointed out that, if a minimum load factor of safety against ultimate carrying capacity is specified (whether it be 1.88, as in the author's example; 1.84, as in the discusser's case; or any other prescribed value), plastic analysis *will always* result in the smallest required section modulus. Other solutions may give no larger members for certain special cases, but they will never result in smaller ones. Mr. Jones' more economical choice was possible only by a decrease in load factor of safety below that assumed in the original article.

Regarding Mr. Jones' statement that plastic analysis "*assumes* that the joint can remain relatively rigid under full plastic moment—a most difficult thing to achieve under usual framing and architectural clearance conditions," it should be noted that the various typical welded connections tested at Lehigh and reported in "Connections for Welded Continuous Portal Frames," by Topractsoglou, Beedle and Johnston (*The Welding Journal Research Supplement*, July and August 1951, and November 1952), do have adequate moment-rotation characteristics. If, however, the rigidity of any given connection is in doubt, a simple and relatively inexpensive solution would be to over-design it and thereby force the "plastic hinge" to develop in the beam or column outside the knee.

The question of safety factor raised by Mr. Wiesinger is of importance regardless of the method of analysis. We agree with the discusser's viewpoint that a more rational approach to this problem would be to take into account the uncertainty associated with the various loads, although a proper weighting of relative uncertainties with respect to this single aspect of design itself is not without uncertainty. Since, in plastic analysis, loads are "stepped-up" by a so-called load factor of safety, nothing prohibits the use of different load factors for different types of loads, using this method of analysis. This situation is not, however, unique to plastic analysis. It could also be taken into account in elastic design.

The discussion by Mr. O'Leary lists "certain limitations" of plastic analysis. The first of these concerns the problem of moving loads. Secondly, it was pointed out that solution based on plastic analysis gives no indication of shear and moment diagrams or deflections at working loads. The third listed limitation has to do with economy and members of variable depth.

With regard to the first of these, nothing prohibits the consideration of several different arrangements of loads to determine the most unfavorable position for design purposes. It should be kept in mind, however, that under certain circumstances, repeated combinations of loads less than those considered critical for static purposes can, when alternated to produce strain reversal, result in increased deformations at each cycle, and thus an eventual collapse of the structure. While recent tests have shown that this condition is not as critical as was anticipated, it is felt that further research work is needed before the methods of analysis discussed in the original paper are extended to the moving-load problem. This work is currently under way.

It is considered that Mr. O'Leary's second listed condition is not a limitation but rather an asset. If for some reason the shear or moment diagram were needed, a conventional elastic solution at working loads could be carried out, but this computation would not be needed in determining the member sizes throughout the structure. Deflections, however, may need to be considered depending on the type of structure. Regarding this problem, it has been observed that in most cases if a load factor of 1.88 is used in the plastic design of continuous structures, the resulting deflections at working loads will be less than for simple beams designed to carry the same loading on the same spans.

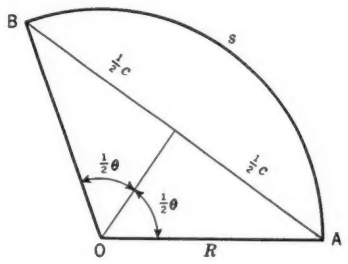
Regarding Mr. O'Leary's third point, even though variable-depth sections can be elastically designed so that they are "efficient" with regard to total weight of structure, the less highly fabricated prismatic shape may, in certain cases, have dollar-for-dollar more to offer. This is evident when considering the resistance to overload of each of the two systems.

ROBERT L. KETTER, J.M. ASCE
Research Instructor
BRUNO THÜRLIMANN
Research Assistant Professor
Fritz Eng. Laboratory, Lehigh Univ.
Bethlehem, Pa.

Circular arc and circular segment easily found

TO THE EDITOR: It is surprising to find on page 61 of the June issue such a complicated solution for such a simple problem, the excuse being the avoidance of the ordinary tables of trigonometric functions.

Given the radius R and the central angle θ of a circular arc, it is required to find s, the length of arc, and A, the area of segment.



Solution:

$$s = R\theta \quad \ldots\ldots\ldots\ldots (a)$$

where θ is measured in radians.

A = area of sector AOB − area of triangle AOB =

$$\tfrac{1}{2}sR - (R \sin \tfrac{1}{2}\theta)(R \cos \tfrac{1}{2}\theta) =$$

$$A = \tfrac{1}{2}R^2(\theta - \sin\theta) \quad \ldots\ldots\ldots (b)$$

Example:

Given $\theta = 90$ deg $= \dfrac{\pi}{2}$ radians,

$R = 200$ ft

$$s = 200 \times \frac{\pi}{2} = 100 \times \pi = 314.16 \text{ ft}$$

$$A = \tfrac{1}{2}(200)^2\left(\frac{\pi}{2} - 1\right) =$$

$$\frac{40{,}000}{2}(0.5708) = 11{,}416 \text{ sq ft}$$

Incidental comments

It has become the fashion for certain professors of mathematics of the pure sort to sponsor the publication of trigonometry texts without tables. This practice is to be deplored, certainly for those students who may drift into civil engineering.

T. F. HICKERSON, M. ASCE
Formerly Prof. of Civil Eng.
University of N.C.
Chapel Hill, N.C.

SOCIETY NEWS

New York Convention to Feature Technical Program and Inspection Trips

An extensive technical program, including several symposiums, unusual field trips, and a post-Convention inspection tour of engineering works in Puerto Rico are on the agenda for the Society's 1955 Annual Convention in New York. Once again the convenient Statler Hotel will be Convention headquarters, and this year's dates are October 24–28. The Convention committee, headed by John R. Zehner, reminds members that New York weather is likely to be at its zestful best in October.

Broad Technical Program

With some thirty Technical Division sessions planned, new developments in practically all civil engineering fields will be covered. The City Planning Division, together with Princeton University and the Urban Land Institute, is sponsoring an all-day Conference on City Planning at Princeton on October 28, the last day of the Convention. City planners are urged to make early plans for participation in this event which will have for its theme, "Transportation Planning."

Trip to Brooklyn Navy Yard

The Divisions are taking full advantage of the construction boom in the New York area to supplement the program with trips to a number of unusual projects. Highlight of the inspection program will be the general Convention trip to the Brooklyn Navy Yard. There members will have a chance to see two supercarriers, *U.S.S. Saratoga* and *Independence*, being built, regular overhaul of the *U.S.S. Wisconsin*, drydock reconstruction, relining of Central Power Plant smoke stacks, construction of a cathodic protection system, installation of reinforced concrete acid pickling tanks, and work on a new type of fender-system pier—to mention a few of the projects under construction.

Committee on Conditions of Practice

Several timely subjects will be presented by the Committee on Conditions of Practice. ASCE Past-President Carlton S. Proctor will be featured speaker at a luncheon meeting on Monday, October 24. His talk, entitled "Engineers Joint Council—National and Regional Unity for the Engineering Profession," should be especially important in view of the growing interest around the country in fostering affiliation of local and regional groups with EJC.

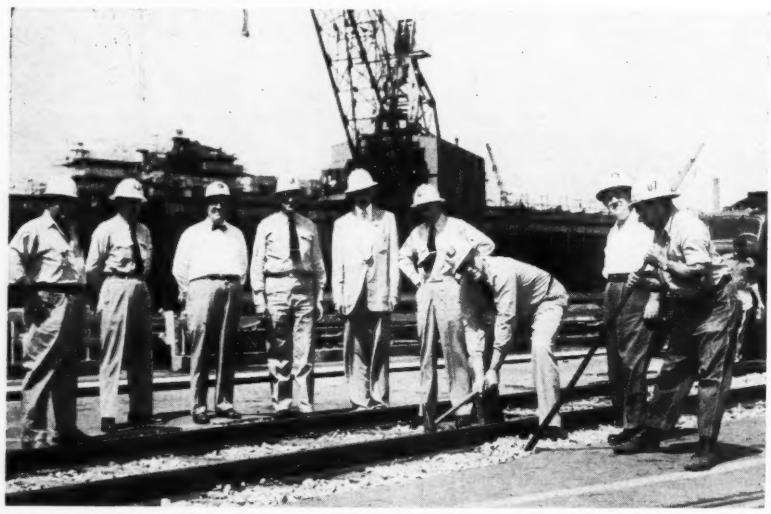
Following the luncheon meeting, the Committee on Engineering Education will conduct a session devoted to the subject, "Engineering Education—How Much Science and How Much Technology?" A member of the ASEE Committee on Evaluation of Engineering Education will be present to discuss the subject matter of the committee's long-awaited final report.

Elaborate Social Program

Ingenuity has produced plans to make the social program appealing to all tastes. To get things off to a good start, the Metropolitan Section will be host to a "Kick-Off Party" Monday evening, October 24, from 5:30 to 7:30. The Statler is reserving tables for those wishing to attend the famed Cafe Rouge for dinner and dancing after the cocktail party. Les Elgart will provide the dance music.

Other highlights of the social program include an Awards Luncheon on Wednesday, October 26, when honorary memberships, the Society's highest honor, will be presented to four members; a dinner-dance and President's reception Wednesday evening; and a smoker Thursday evening. Luncheons and dinners are also being planned by the Divisions, alumni organizations, and other groups.

Every effort will be made to encourage the wives to attend, too. The Women's Entertainment Committee, headed by Mrs. John R. Zehner, has scheduled trips, teas, shows—so many interesting events, in fact, that we are going to have to print a special program just for the women. Highlight of the ladies' trips will be an all-day tour of historical spots in beautiful Westchester County.



Construction projects at Brooklyn Navy Yard (*U.S.S. Saratoga* in the background) will be objective of one of the most interesting Annual Convention trips. Adm. R. T. Cowdrey drives last spike in crane-rail track on drydock No. 6, reconstructed to permit construction of supercarrier *U.S.S. Independence* at Brooklyn Navy Yard, scene of interesting N. Y. Convention trip. With the Admiral are Comdr. P. W. Roberts and Capt. R. T. Simpson (fourth and sixth from left).

Puerto Rico dedicates its new $15,000,000 air terminal. The project features 8,000-ft-long runways and a parking area large enough for more than 900 cars.

Beautiful and famed Condado Beach is the most rapidly expanding section of Puerto Rico. Caribe Hilton Hotel, headquarters for the post-Convention tour, shows in the distance.

President to Head the Post-Convention Tour

The Convention is going to be a good one and a long one, and it is going to end excitingly with a trip to Puerto Rico and a chance to inspect the impressive construction projects going up everywhere on that island. The tour, which will be headed by the Society's President and his wife, is being arranged to meet the interests of both engineers and ladies of the party. Mindful of the enthusiasm of members making the 1954 post-Convention tour, the Committee is providing more extensive facilities for this tour. None the less, only eighty can be accommodated, with reservations accepted in order of receipt.

For this five-day inspection trip, the Puerto Rico Section, the Puerto Rico Development Administration, and Pan-American World Airways are cooperating with the Annual Convention Committee on Arrangements. The group will leave New York either Friday night, the 28th, or Saturday morning, by Pan American World Airways for a short flight to San Juan's new Isla Verde International Airport. Hotel headquarters will be the gorgeous Caribe Hilton on the beach. Projects of interest to engineers, in addition to the airport, include port facilities, highways, public housing, radical new building designs, and industrial plants. Adequate time, of course, will be allotted to sightseeing, entertainment and recreation, with the Puerto Rico Section and government officials making the arrangements.

For those who can take the time, a few extra days in Charlotte Amalie, St. Thomas, are being planned. The exotic Virgin Isles Hotel will be home base for this fortunate group of travelers. The return trip to New York on November 5 (or November 2 for those who decide not to make the St. Thomas trip) will also be by air, providing maximum time in the islands.

The full tour price per person (when two travel together) for the Puerto Rico trip is $225. This includes air transportation and transfer between airport and hotel, the hotel for four nights, engineering and sightseeing tours, receptions, fashion shows, cocktail parties, and an all-day beach fiesta. The cost of the St. Thomas trip will be an additional $62 per person (when two travel together). Included in the latter rate are air fare and transportation between airport and hotel, the hotel for three nights, two meals a day, a sightseeing tour, cocktail party and barbecue.

To assure making this unusual trip, early reservations are essential. Remember that only eighty can go. Full information and descriptive pamphlets are available from Charles Benisch, Pan American World Airways, 80 East 42nd St., New York 17, N.Y. All details of planning are being handled through that address. A coupon is printed on page 85 of this issue. It may be used to obtain further information and to make reservations for this tour. A $50 deposit per person is required for reservation.

Hotel Reservations Must Be Made

A large block of rooms has been set aside at the Statler for the Convention. Reservations should be sent direct, and addressed to: ASCE Convention Reservations, Hotel Statler, Seventh Avenue & 33rd Street, New York 1, N. Y.

Program in September Issue

The full Convention Program, including the Princeton Conference on Transportation Planning, will be printed in the September issue.

Board Studies Advertising for Professional Services

At its June meeting in St. Louis the Board of Direction studied the subject of advertising for professional services, as presented in the report of the Committee on Professional Practice. It accepted a recommendation that the section of the report dealing with advertising by engineering firms be approved in principle and that it be given publicity, including publication in CIVIL ENGINEERING, before considering formal adoption.

The report of the Committee on Professional Practice states that returns from a questionnaire sent out by the committee confirm its opinion that Provision 7 in the Code of Ethics should be amended to read:

"It shall be considered unprofessional and inconsistent with honorable and dignified bearing . . . to use or countenance any paid advertisement of professional engineering services, or to use or permit any publicity derogatory to the profession."

Provision 7 currently reads: "To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession."

Paid advertising, the report explains, "shall not be deemed to include 'want ads' nor any listing in a professional directory, nor any listing in other directories pro-

vided that such listings shall be of the same size and nature as similar listings by other professional engineers listed therein."

"Factual statements, with or without illustrations, pertaining to an engineer's professional activities made by himself or by others for him, such as public relations counsel, may be made in the public press, radio, television, or other media . . ." However, the report emphasizes, the tenor of such statements must be dignified "to the end that knowledge of the engineer's function in society and the standing of the profession as a whole shall be advanced" rather than the mere personal aggrandizement of the individual. It stipulates further that "the engineer shall not take part, or give assistance in obtaining advertisements or other support toward meeting the expense of any publication illustrating his works, nor shall he permit others to solicit such advertisements or support in his name."

New Daniel W. Mead Prize Contest Open

Student Chapter members beginning a new school year and Junior Members are reminded that a new (1956) Daniel W. Mead Prize Competition for papers on some phase of professional ethics is open.

At its St. Louis meeting the Board of Direction approved two subjects. Junior Members will write on "Responsibilities of the Architectural Firm and the Engineering Firm on a Cooperative Undertaking." The Student Prize topic will be "Ethics of the Senior in Making Commitments with Prospective Employers." All papers intended for entry in the competition must be in the hands of the Executive Secretary of ASCE by May 1, 1956.

Established and endowed in 1939 by the late Daniel W. Mead, Past-President and Honorary Member of ASCE, the prizes consist of a Junior Member award of $100 in cash and a certificate and a Student Prize of $50 in cash and a certificate.

New Adviser for ESPS Office in San Francisco

Walter L. Dickey, A.M. ASCE, civil and structural engineer for the Bechtel Corp., San Francisco, has been appointed by Howard C. Wood, chairman of the San Francisco Section, to serve as Section representative on the San Francisco Advisory Committee of the Engineering Societies Personnel Service. He replaces H. M. Engle, M. ASCE, who has resigned after six years of service.

Tells Canvass Ballot for 1956 ASCE Officers

To the Secretary
American Society of Civil Engineers:

June 30, 1955

The Tellers appointed to count the Ballot for Official Nominees report as follows:

For Vice-President—Zone I
(Term October 1955–October 1957)

Frank A. Marston	744
S. C. Hollister	430
Scattering	142
*Ineligible Candidate	108
Void	1
Blank	20
Total	1,445

For Vice-President—Zone IV
(Term October 1955–October 1957)

Glenn W. Holcomb	1,045
Scattering	359
*Ineligible Candidate	85
Void	0
Blank	30
Total	1,519

For Director—District 1
(Term October 1955–October 1958)

John P. Riley	293
Stanley M. Dore	54
Scattering	140
*Ineligible Candidate	94
Void	0
Blank	25
Total	606

For Director—District 3
(Term October 1955–October 1958)

Carey H. Brown	251
Scattering	26
*Ineligible Candidate	0
Void	1
Blank	3
Total	281

For Director—District 5
(Term October 1955–October 1958)

Mason C. Prichard	28
William H. Richards	11
Scattering	61
*Ineligible Candidate	45
Void	0
Blank	1
Total	145

For Director—District 7
(Term October 1955–October 1958)

Robert H. Sherlock	207
Scattering	38
*Ineligible Candidate	66
Void	0
Blank	4
Total	315

For Director—District 11
(Term October 1955–October 1958)

R. Robinson Rowe	461
Scattering	129
*Ineligible Candidate	89
Void	2
Blank	27
Total	708

For Director—District 12
(Term October 1955–October 1958)

Louis E. Rydell	384
Scattering	49
*Ineligible Candidate	39
Void	0
Blank	19
Total	491

For Director—District 16
(Term October 1955–October 1958)

Clarence L. Eckel	422
R. N. Bergendoff	380
Scattering	34
*Ineligible Candidate	0
Void	0
Blank	1
Total	837

Total number of ballots counted	6,347
Ballot envelopes without signature	10

Respectfully submitted,
ALBERT P. LORIOT
Chairman
ARTHUR J. FOX, JR.
Vice-Chairman

Gordon Wallace
Thomas J. Wickman
Gerard F. Fox
Harry P. Rode, Jr.
Louis J. Capozzoli, Jr.
Robert S. Foote
Austin E. Brant, Jr.
Daniel Koffler
(*Tellers*)

* These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI, of the Constitution.

Maj. Gen. Claude H. Chorpening

Receives 1954 Wellington Prize

Society's Wellington Prize for 1954 finally catches up with last year's recipient, Maj. Gen. C. H. Chorpening, M. ASCE, at Eighth Army Headquarters in Japan, where he is Assistant Chief of Staff, G-4 Section. Presentation is belatedly being made by Sgt. Robert L. Nicholls, J.M. ASCE, of Lincoln, Nebr., now assigned to the Construction Division, Engineer Section, Eighth Army Headquarters. General Chorpening was last year's winner of the Wellington Prize for a "Transactions" paper on "Waterway Growth in the United States."

Four New Honorary Members Elected

As announced in the July issue, four members of the Society were elected to honorary membership in ASCE during the St. Louis meeting of the Board of Direction. They are Frank A. Banks, Leo O. Colbert, Park H. Martin, and John I. Parcel. All have accepted, and their biographies and photographs will be published in the September issue.

Mr. Banks has been connected with the Bureau of Reclamation throughout his career, and now serves it in a consulting capacity, with headquarters at Coulee Dam, Wash. Widely known as a builder of great dams and for his work in natural resource development, he has been consultant to the Government of India on difficult dam projects, and is one of two American members of the International Columbia River Engineering Committee for development of the water resources of the Columbia Basin where Canada is concerned.

Admiral Colbert has had a distinguished career in the U.S. Coast and Geodetic Survey, which he entered in 1907. For twelve years he was director, and under his management all branches of the Survey's work were expanded and developed. He lives in Washington, D.C.

A native of Pittsburgh, Mr. Martin has been largely responsible for the planning, design, and development of such major projects in the city's improvement program as the Penn-Lincoln Parkway. As executive director of the Allegheny Conference on Community Development for the past ten years, he has been widely hailed for the success of his work for community betterment.

Professor Parcel has combined a teaching and consulting career and achieved distinction in both. From 1909 to 1936 he was on the University of Minnesota staff, attaining the position of head of the structural engineering department. Since 1928 he has been in civil engineering partnership with L. J. Sverdrup, a former pupil at the University of Minnesota. Professor Parcel has been active in the ASCE Structural Division for the past twenty-five years.

New Benefits Available In Group Disability Plan

In a recent circular letter Executive Secretary William H. Wisely advised the membership that as of August 1, 1955—sixth anniversary of the Society's Group Disability Plan—a "Senior Plan" has been made available to serve members whose benefits under the Plan have previously terminated at the age of 70.

The Senior Plan, which was approved by the Board of Direction at its June meeting, offers hospital and surgical coverage. The Senior Plan is available only to members who have been insured under the Group Disability Plan for five years prior to age 70. Coverage will continue up to age 80—if the member is gainfully employed and retains his membership in the Society. Weekly indemnity payments are not available under the Senior Plan.

Three individual plans have now been approved by the Board of Direction—the basic contract and two special plans designed to meet the needs of the Society's Junior and Senior groups.

Bylaws Amended for Members with Temporary Addresses

A change in the Society bylaws (Article IX, Section 4) to permit a member to retain his address with the Local Section of his choice, while he is at an APO, or other temporary address, was voted by the Board of Direction at St. Louis.

The amended bylaw—a redraft of a proposed amendment studied at the San Diego meeting—specifically states that, "Members who request mailing address changes to APO numbers or who request other temporary changes in mailing address shall remain assigned to the respective Local Sections of their individual addresses of record unless and until specific requests are made by them for changes in their addresses of record."

Under the provisions of the former bylaw, members with APO addresses were automatically assigned to District 1.

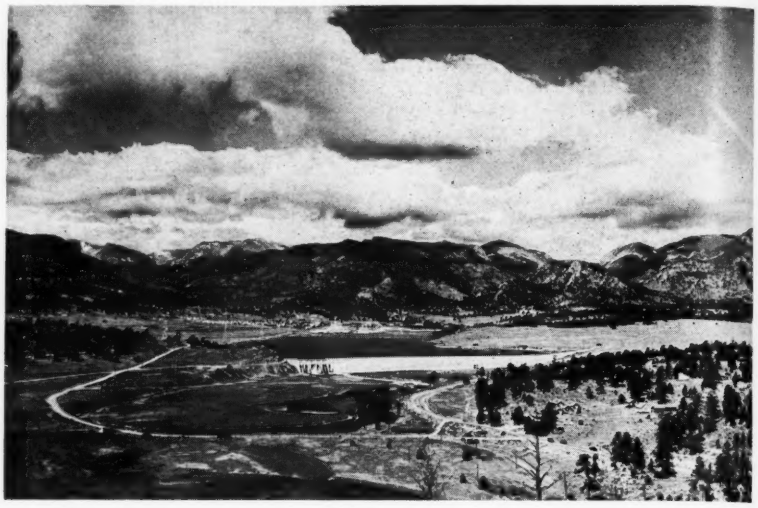
ASCE MEMBERSHIP AS OF JULY 8

Members	8,980
Associate Members	11,544
Junior Members	17,989
Affiliates	70
Honorary Members	39
Total	38,622
(July 9, 1954	37,601)

Irrigation and Drainage Conference in Denver

A field tour of the Colorado-Big Thompson Project on Saturday, September 10, will conclude the Irrigation and Drainage Conference to be held in Denver, September 8–9. This tour of one of the world's largest multiple-purpose irrigation, power, and recreation projects will include a trip across the Continental Divide over the famous Trail Ridge Road, many miles of which are at an elevation about 12,000 ft.

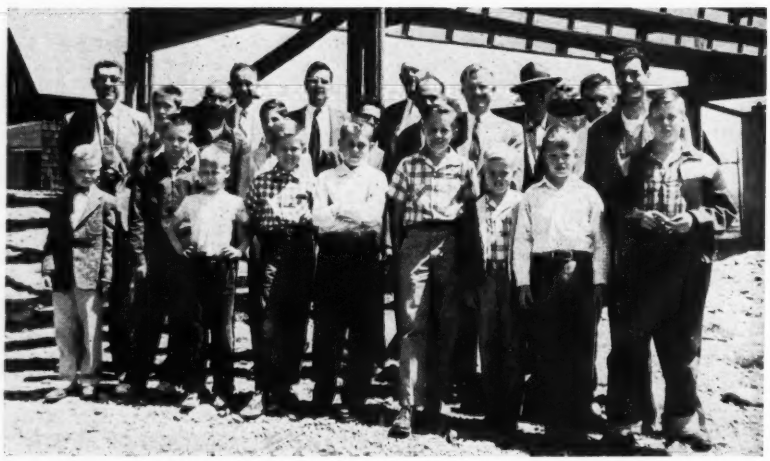
Engineers are requested to make their own hotel reservations as soon as possible. Headquarters for the conference will be the Albany Hotel in Denver, which promises excellent, air-conditioned accommodations at $4.50 to $7.00 for single and $9.00 to $12.00 for twin-bed rooms. Good accommodations are also available at comparable rates at other first-class hotels and motels in Denver.



Visitors on field tour highlighting the Irrigation and Drainage Conference in Denver in September will see Olympus Dam and Lake Estes on the Eastern Slope, with historic Estes Park Village nestled at the foot of the Continental Divide (seen in the background).

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)



Future engineers are out in full force for "Father-Son Inspection Trip" sponsored by the Providence Section on May 21. Adults in the group are (in usual order) C. Bernard Clarke, vice-president of Providence Section; Charles Bissell; John Graass; Daniel C. Drucker, past-president, Providence Section; Daniel O. Cargill, state bridge engineer; Norman Paquette; Waldo W. Smith, president of Providence Section; Brad Wooley; and John F. Westman, committee chairman for the trip. The group visited the Sakonnet River Bridge now under construction and the U.S. Naval Base at Newport, where a warehouse and pier are going up. Mr. Cargill discussed the bridge, and there was a spokesman for the Navy at the Base.

Coming Events

Maine—Joint meeting with the New Hampshire Branch—field inspection of new Portsmouth Air Force Base, August 27.

Mid-South—Annual fall meeting at the Claridge Hotel, Memphis, Tenn., October 20–22.

Northeastern—Luncheons with short talks at the Boston City Club, 14 Court Square, August 17 and September 21, at 12 noon. Reservations must be made the day before (price $1.25).

San Francisco—Section will be host to a Hydraulics Division Convention at the University of California, Berkeley, August 24–26.

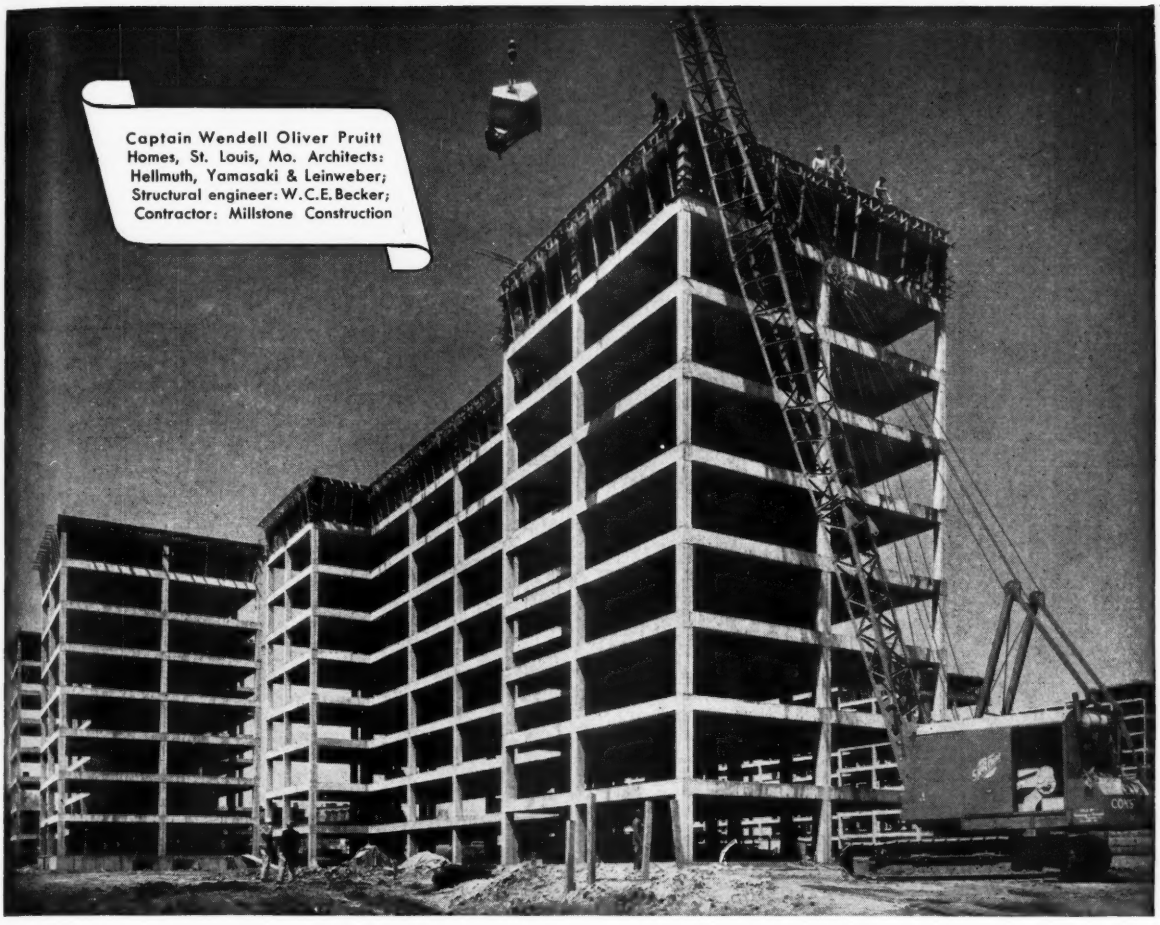
Texas—Fall meeting at the Texas Hotel, Fort Worth, Tex., October 13–15.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N. Y.
Hotel Statler
October 24–28, 1955

DALLAS CONVENTION
Dallas, Tex.
Hotel Baker
February 13–17, 1956

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956


Captain Wendell Oliver Pruitt Homes, St. Louis, Mo. Architects: Hellmuth, Yamasaki & Leinweber; Structural engineer: W.C.E. Becker; Contractor: Millstone Construction

Concrete Frames and Floors

...MONEY-SAVING CONSTRUCTION FOR MODERN APARTMENT BUILDINGS

The St. Louis Housing Authority chose reinforced concrete frames and floors for its Captain Wendell Oliver Pruitt Homes. On 34½ acres, the project includes 20 eleven-story buildings, two million sq. ft. of floor area.

Critically-needed housing projects like the Pruitt Homes can be built faster and with greater economy when designed for concrete frames and floors. Those are two reasons why more and more modern apartment buildings are being built with this type of framing.

Reinforced concrete frame and floor construction offers architects, engineers, contractors and owners many advantages. For example, frame and floor construction proceed simultaneously. Walls can be finished as the building goes up. Facilities for heating and ventilating, as well as plumbing and wiring can be installed as the structural work progresses. This saves time and money.

Competitive bids and cost analyses show that savings up to 40% on frame and floor costs are possible with concrete. Concrete is sturdy and firesafe, gives years of service with little upkeep. This ***low annual cost*** is a bonus for owners, investors and tenants.

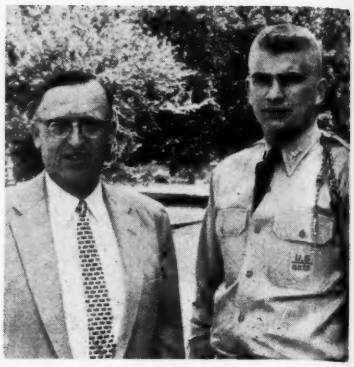
For help in designing reinforced concrete frames and floors for structures of any size or for any purpose—for apartments, schools, hospitals or commercial buildings—write for free illustrated literature. Distribution is limited to the United States and Canada.

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

8-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

Inspection trip takes Maryland Section members to new Ashburton Filtration Plant, which is being built by Baltimore Bureau of Water Supply at approximate cost of $12,000,000. In the foreground are Gustav J. Requardt (left), whose firm designed the plant, and W. L. Chilcote, president of Maryland Section.

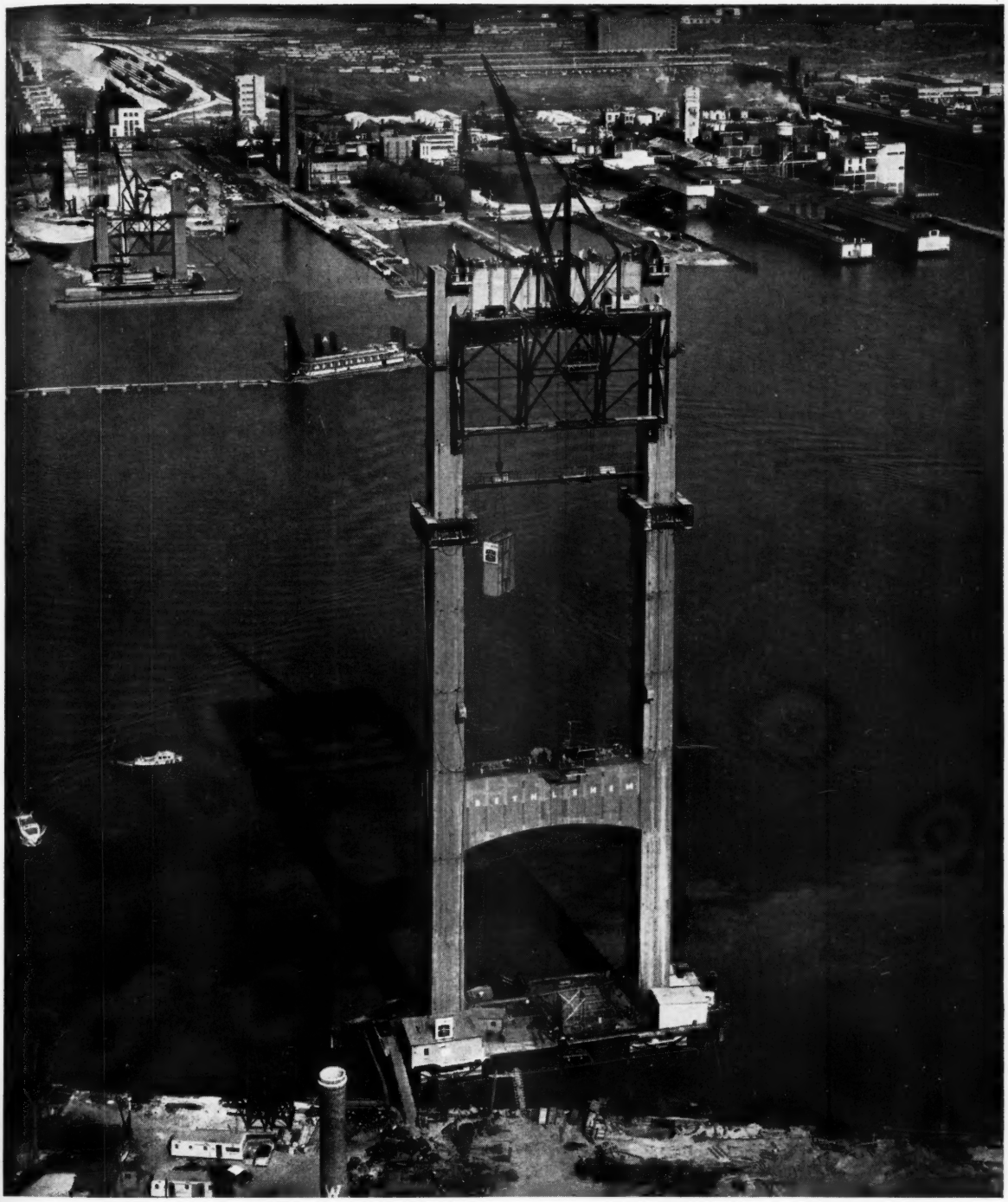


Representing Mid-South Section, L. A. Tvedt, University of Mississippi Student Chapter Contact Member, presents Section's annual Award of Merit and $30 to John A. Johnson, of Henderson, Tenn. Next year Mr. Johnson will study in Paris and work in the Freyssinet engineering offices there. Similar awards of merit were presented to Malcolm E. Herrington, of Mississippi State College, and Billy K. Cooper, of University of Arkansas. In addition to these three awards, Section also gives prizes for six student papers read at Section meetings.

In Frankfort for recent Kentucky Section meeting are (left to right) Section President G. R. Watkins, ASCE Past-President Daniel V. Terrell, C. M. Brown, Jr., C. G. Grayson, J. F. Rice, ASCE Director D. S. Corbett, and L. E. Gregg, chairman of District 9 Council. Messrs. Brown, Grayson, and Rice were speakers of the evening in a competition to select the Section's representative to the annual District 9 Terrell Award Contest. All spoke on "Unionization and the Young Engineer," with Mr. Grayson adjudged the winner.

Special train takes some 250 members of Houston Branch of Texas Section to inspect the Southern Pacific Railroad's new $7,000,000 Englewood Gravity Switching Yard. Loud speakers carried running commentaries by Southern Pacific personnel as train went through the yard. Ultramodern automatic operation, involving electronic weighing, speed measurement, car retarders, and classifying of freight cars, was demonstrated and explained as two trains were put over the crest of the yard. Trip was arranged by L. A. Loggins, branch vice-president and chief engineer for S. P. Guests of the Houston Branch included ASCE Vice-President Mason Lockwood and Director Raymond Dawson and Robert Lowry, president of the Section.

Culminating five years of effort by the Seattle Section and other engineering groups, an appropriations bill establishing a state agency for surveys and maps is signed by Gov. Arthur B. Langlie at the end of 1955 session of the Washington State Legislature. Shown, in usual order, are Glenn W. Moore, chairman of Seattle Section's Surveying and Mapping Committee; Senator W. D. Shannon, Seattle consultant and sponsor of the bill in the Senate, A. M. Sobieralski, chairman of State Advisory Board on Surveys and Maps; Carl M. Berry, Seattle consultant and member of the executive committee of the Society's Surveying and Mapping Division; and Governor Langlie. Washington has been one of the most backward states in preserving its surveys and maps.

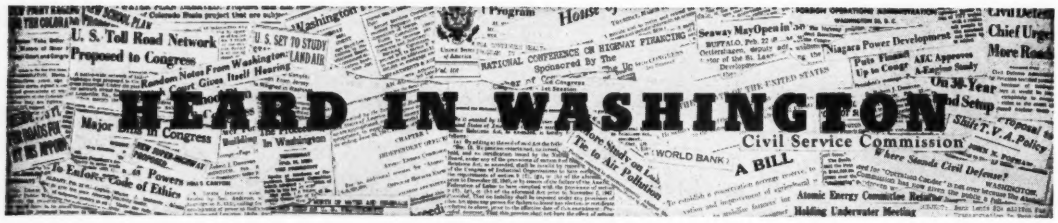


Topping the Tower—On May 12, just 20 weeks after the first tower section was bolted to the pier, a Bethlehem erection crew closed the upper strut of the Jersey-side tower for the $90,000,000 suspension bridge between Philadelphia and Gloucester City, N. J. Rising 378 ft above the Delaware River, the tower contains over 5000 tons of steel. The main span of the bridge, 2000 ft from tower to tower, will be the eighth longest suspended span yet built. Engineers are Modjeski & Masters-Ammann & Whitney for the Delaware River Port Authority.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL


HEARD IN WASHINGTON
U. S. Toll Road Network Proposed to Congress
U. S. SET TO STUDY LANDAIR
Civil Service Commission
A BILL
Chief Urges More Roads
Shift T. V. A. Policy

JOSEPH H. EHLERS, M. ASCE — **Field Representative ASCE**

The present session of Congress will probably have ended before this report reaches you. Many essential routine bills and laws renewing or continuing existing policies have been enacted. These include important appropriation bills, in many instances containing sizable increases in funds, and quite a few radical proposals have been debated and considered. Many of them will be left over for action in the 1956 session or so watered down that they cannot be considered as establishing bold new policies.

Foremost on the list of bold, precedent-shattering undertakings which ran into trouble is the President's great **Highway Program.** The Senate passed an opposition measure. The House has a bill containing drastic tax increases, particularly on motor fuel and truck tires. The general theory is that future taxes collected from motorists should be equated to road building expenditures even though no linkage between the two is recognized and no specific ear-marking takes place.

It has always been considered likely that some highway bill would be passed. The present confusion may clear up quickly but if any bill passes before Congress adjourns, it will be a much watered-down version of the grand plan. **ASCE testified** before both Senate and House Committees.

[Defeat of both highway bills by the House on July 27 apparently ended prospects for highway legislation at this session.]

One important piece of pioneer legislation has emerged as Public Law 159, relating to the **control of air pollution**. The problem will be approached on a broad base. The Public Health Service will have basic responsibility for carrying on activities in this field, including research, aid to the states and the development of a comprehensive program. Up to $5 million a year is authorized. An Air Pollution Control Advisory Board will be named, composed of government officials and six non-government members, one of whom is required to be an engineer.

The House passed a bill extending **Social Security** coverage to additional self-employed professional workers, including lawyers but excluding doctors. The eligibility age for women would be lowered. However the Senate probably will not conclude its hearings on the subject before adjournment.

Mid-July confusion presently prevails in respect to the Upper Colorado River legislation, the school construction and the housing bills.

Engineers Joint Council has been interested in bills to authorize construction of a new $36 million **Museum of History and Technology** for the Smithsonian Institution. Its construction has now been authorized by Public Law 106 and the preparation of preliminary plans is expected to begin soon.

The Field Representative testified before the House Ways and Means Committee on behalf of Engineers Joint Council in favor of H.R. 9 and 10, the **Individual Retirement Act of 1955.** These bills would assist self-employed professional men in building up a retirement fund. The legal and medical professions gave eloquent support to the measure.

Following the hearing, the full Ways and Means Committee of the House favorably reported the bill. This does not necessarily indicate its probable passage. The Secretary of the Treasury, although conceding the equity of the proposal, testified that the Treasury could not yet bear the burden of tax losses incidental to it, which he estimated at over a billion dollars a year. Under the approved bill, self-employed engineers and other professional men would be exempt from the payment of **income tax** on up to 10 per cent of the income used to purchase a form of retirement annuity contract.

It is the concensus of the **U.S. Chamber of Commerce Construction Department Committee** that 1955 will be a record year both in terms of physical volume and of dollar volume, with a total of over $41 billion for the year.

Hoover Commission Report

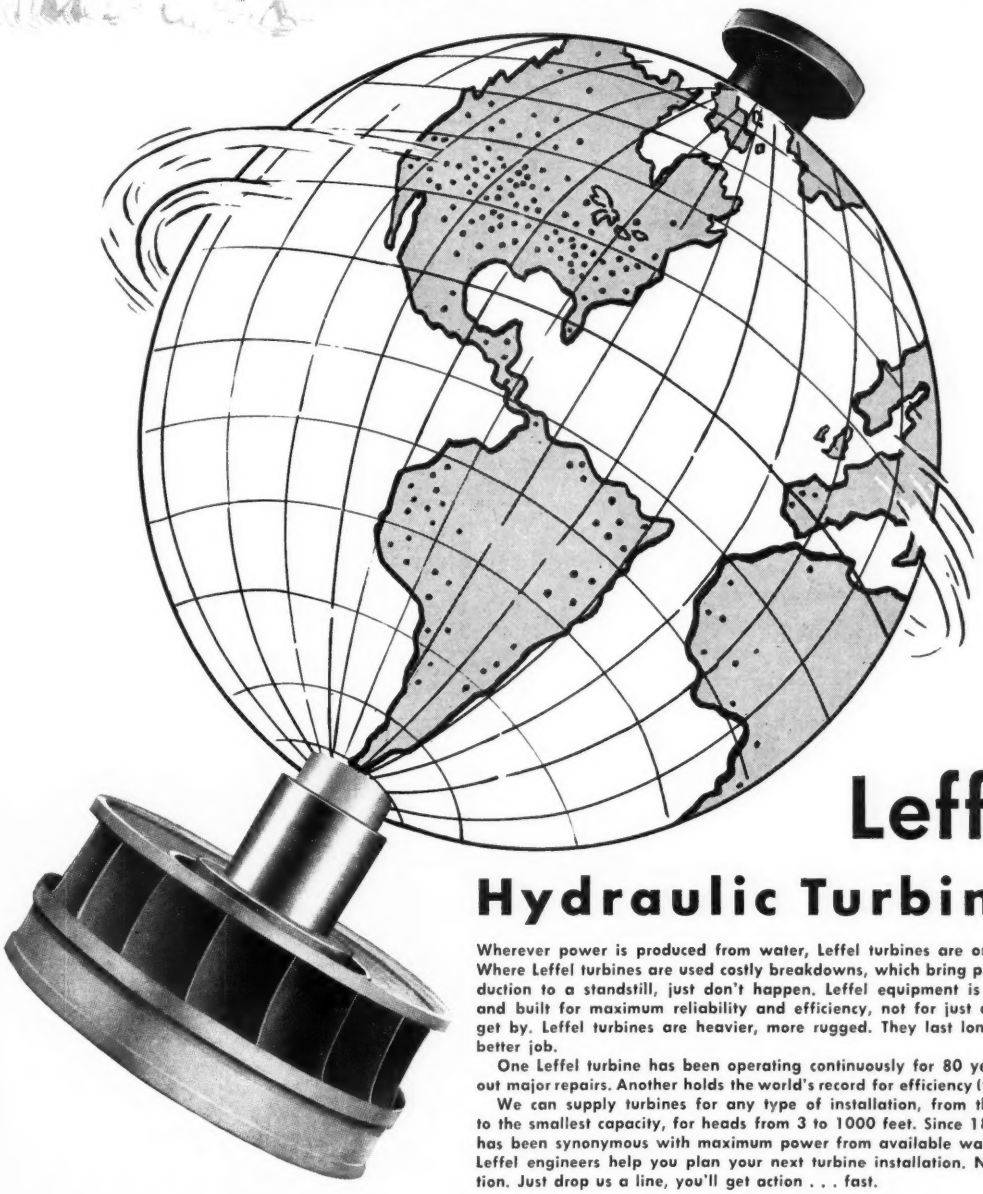
Thoughtful students of government policy and operations will find stimulating reading in the various reports of the Commission on Organization of the Executive Branch of the Government (**Hoover Commission**). Of particular interest to engineers is the Report on Water Resources and Power (Available from Government Printing Office—price $0.85). Many ASCE members played an active part in the Task Force from which this report was developed.

A Water Resources Board is recommended to be created from existing inter-agency groups but including five public experts. This Board would recommend broad policies and devise methods of coordination. Government power-production bookkeeping would be put on a basis comparable with private industry. In the Task Force report illustrations of duplication of effort and of exaggerated calculations of benefits are given. Irrigation, navigation, flood control and power are discussed.

Other reports by the Commission relate to loan agencies dealing with construction and engineering matters. Numerous bills to effectuate the Commission's recommendations have been introduced but will not come up for discussion until Congress reconvenes next January.

Washington, D.C.
July 26, 1955

POWER
from the waters of the world



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Hydraulic Turbines

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We can supply turbines for any type of installation, from the largest to the smallest capacity, for heads from 3 to 1000 feet. Since 1862 Leffel has been synonymous with maximum power from available water. So let Leffel engineers help you plan your next turbine installation. No obligation. Just drop us a line, you'll get action . . . fast.

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NEWS BRIEFS . . .

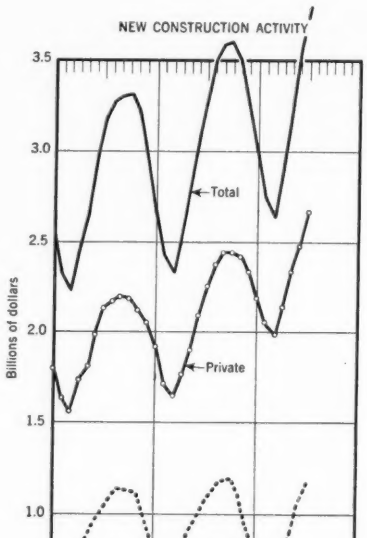
June Construction Activity Sets Record for the Month

Private construction, at $2.6 billion this June, was at peak for the second successive month. Public construction activity, at $1.2 billion, was also at record levels for the month.

For the first half of the year, the total volume of new construction was 14 percent higher this year than last. Among the types of construction activity showing the greatest advances over the year were store building (42 percent), housing (34 percent), churches (33 percent), and public schools (19 percent), reflecting the widespread development and servicing of residential communities. Construction of military facilities also rose significantly, principally because of mounting work on Air Force facilities.

The most substantial decrease from 1954 (45 percent) was in public industrial construction, resulting from a steady and sharp decline in activity on atomic energy projects, which began early last year. Also down from last year was farm and railroad construction, as well as work on public housing, public hospitals, and conservation and development projects. The drop in conservation and development has occurred exclusively on reclamation and TVA projects, while navigation and flood control work has continued at last year's levels.

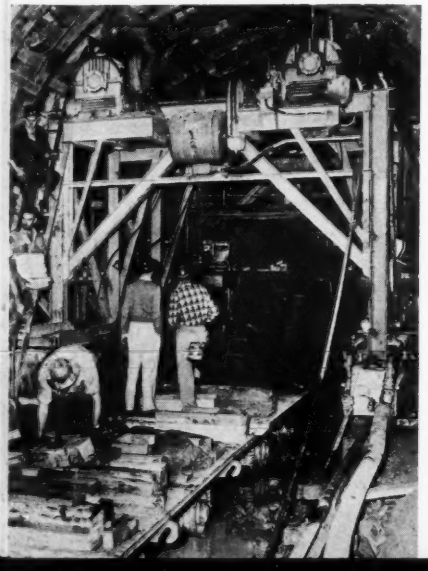
Private construction as a whole is 20 percent higher this year than last, when the first six months are compared, whereas public construction has been about the same in both years. Sizable increases in state and locally owned construction, principally on highways, schools, and sewer and water facilities, and the rise in military construction just about offset declines in most types of federally owned projects. Among the types of state and local construction for which federal aid is given under prevailing statutes—notably school and hospital building and highway work—federal grants constituted about 3 percent of the total expenditures for state and local school projects during the first half of 1955, 10 percent of expenditures for hospitals, and 17 percent of highway spending.



Record expenditures for new construction in June, at $3.8 billion, bring total for first half of the year to record-breaking $19.1 billion—14 percent above 1954 total for same period—according to Department of Commerce curves.

Outlays for new construction rose seasonally in June 1955 to $3.8 billion, the highest monthly figure on record, according to preliminary estimates of the Departments of Labor and Commerce. The June figure brought the total dollar volume of new construction for the first half of the year to an all-time high of $19.1 billion. This represents a seasonally adjusted annual rate of $41.7 billion, 11 percent higher than the total of $37.6 billion of work put in place in 1954, the previous peak year.

Through virtually all types of construction shared in the 7 percent rise between May and June, most of the increase resulted from expansion of house and store building and highway work. The building of stores and similar commercial establishments has been at an all-time high since March. Outlays for private industrial building increased more than seasonally last month to the largest June total on record.



World's Tunneling Record Established on Snowy Mountains Project in Australia

American contractors at work on the Snowy Mountains Project in southeast Australia have set a world's tunneling record of 402 ft in six days on the $60,000,000 hydroelectric project. Photo shows drilling jumbo and tunneling crew boring the 14-mile 24-ft-dia Eucumbene Tumut Tunnel, which is being driven through a complex geological stratum of slate and quartzite deposited on granite. The record advance was established during the week ending May 28 by a crew of 144 men working in three shifts around the clock. The best day's advance was 71 ft, also a record. A combination of American, Australian British and Swedish equipment is being used. Kaiser Engineers Division of Henry J. Kaiser Co. heads a combine of American contractors on the project.

Pascagoula, Miss., Plans Better Harbor Facilities

The Board of Supervisors of Jackson County, Mississippi, recently retained the firm of Michael Baker, Jr., Inc., consulting engineers of Rochester, Pa., and Jackson, Miss., to plan industrial harbor facilities at Bayou Casotte, adjacent to the City of Pascagoula, Miss. The 1954 state legislature authorized a $2,000,000 bond sale for the project.

Preliminary plans call for a 30-ft channel into Bayou Casotte from an existing channel about three miles out in the Gulf of Mexico.

Comments Sought on Proposed Drafting Standards

Tentative draft copies of the Proposed American Drafting Standards Manual—Dimensioning and Notes, are being distributed to a selected group of individuals for review and comment. Although this report does not represent a consensus of the American Standards Association Subcommittee No. 5, it is being circulated for comments that should be helpful in reconciling the differing viewpoints within the subcommittee.

Engineers interested in reviewing the tentative draft and sending their own comments to the committee should write to Mr. E. N. Brown, Chairman, Subcommittee No. 5, American Society of Mechanical Engineers, 29 West 39th St., New York, 18, N.Y. The period for comments will close on September 21, 1955.

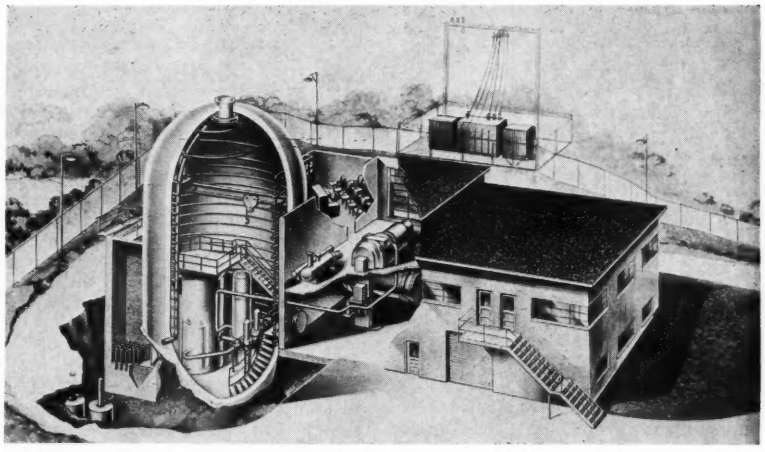
American Nuclear Society Elects First Officers

W. H. Zinn, of Lemont, Ill., has been elected first president of the American Nuclear Society, the world's first professional society of scientists and engineers engaged full time in industrial, government, or educational aspects of atomic energy. A pioneer in the American atomic program and authority on nuclear reactor design, Dr. Zinn is director of the Argonne National Laboratory of the AEC. Announcement of his election was made at the society's first annual membership meeting at Pennsylvania State University in late June.

Other officers elected by the society are Philip Sporn, M. ASCE, president, American Gas & Electric Co., New York, vice-president; and Karl Cohen, vice-president, Walter Kidde Nuclear Laboratories, Inc., Garden City, N.Y., treasurer.

The newly formed organization has 850 members.

Stone and Webster to Build Army Power Reactor



With the Stone and Webster Engineering Corp. named as engineer-constructor for the first Army Package Power Reactor, construction of the unit will get under way in September at the Army's Engineering Research and Development Laboratories at Fort Belvoir, Va. The small (1,700-kw) power plant will employ components that can be transported by air to remote bases in any part of the world. This engineer's drawing shows how the portable nuclear reactor plant (in cutaway diagram of protective steel container at left) can be linked to existing steam generating plants. The Army's plan to build a portable reactor was announced last fall (October 1954 issue, page 83).

AWWA Has 75th Anniversary Meeting

Water works officials from all corners of the United States—gathered for the 75th annual conference of the American Water Works Association in Chicago, June 14–17—discussed the many problems attendant upon keeping their communities adequately supplied with their most valuable asset, water. Although the program covered many aspects of the subject, the new patterns of water use resulting from the rapid growth of suburban communities took a prominent place on the program.

W. F. Shephard, director, Division of Engineering, Michigan State Department of Health, noted that, "In Michigan all public supplies are under the supervision and control of the state health commissioner, assuring at least reasonably adequate standards of construction and operation." Although the speaker found the problem of financing not too difficult, he did emphasize that "The time element for bringing about the actions necessary to adjust the water supply to the changed conditions due to population influx is a serious problem that requires a thorough integration of all types of community motivations and educational devices and, most of all, plain hard work."

Lawn-sprinkling loads have become a particular "Juggernaut" to water suppliers. Edward F. Tanghe, superintendent, Milwaukee Water Works, summarized the factors making the problem more acute: "Consumers are moving from the older, more congested areas to the outskirts and the suburbs. This means longer distances for the water to travel from the pumping stations to the consumers. Invariably the lots in the newer areas are larger, with more expansive lawns. The new areas, as a rule, are higher in elevation. This makes most difficult the maintenance of good pressures during peak demands."

A combination of large storage units filled over-night and distributed on hot days and mild sprinkling restrictions have apparently solved the problem. The restrictions have cut the peak demand from 3.8 to 2.5 times the yearly average. There has been no reduction in the total use of water for lawn sprinkling because of these restrictions.

By way of maintaining community good will while installing the required increased pumping facilities, Peter Ley, vice-president and chief engineer, Jamaica (N.Y.) State Supply Co., said that his company adopted the following policy: "In each community where a new station was built, an effort was made to follow closely the prevailing architectural styles of nearby homes. Storage facilities were designed entirely underground or with only a few feet above ground level. The land surrounding well houses and storage tanks was attractively landscaped." He noted that, "Although the cost of these attractive facilities is estimated to be about 25 percent more than the older type of purely functional structures, the management of the company feels that the additional expense is fully justified."

Nuclear wastes and their effect on water

supply also aroused considerable interest during the conference. A water-sampling program to study the effect of radioactive fallout was discussed at length by Rolf Eliassen, M. ASCE, professor of sanitary engineering at M.I.T.

The need for finding some satisfactory method of disposal of radioactive wastes was elaborated by W. A. Rodger, J.M. ASCE, associate director, Chemical Engineering Division, Argonne National Laboratory. Mr. Rodger concluded that "Two things are clear. Some ultimate disposal method must be found. Liquid storage is not it. A reduction of solids is necessary. The need for a decision on the ultimate disposal area and methods is indicated."

One of the blessings of the modern householder, detergents, is something else again for those responsible for supplying clean, potable water to communities. Increased use of these detergents has caused considerable trouble in many communities, such as foaming at the treatment plant, fishy taste and aroma in the drinking water, and filtered water remaining colored. Studies of methods to overcome this difficulty were reported by James C. Vaughn, Ralph F. Falkenthal, and Robert W. Schmidt, South District Filtration Plant, Chicago. The studies made at South District Filtration Plant indicated that, "The use of alum with activated silica was found to be helpful in coagulation at Appleton and Ossawatomie. Chlorine dioxide was helpful at Wheeling and Ossawatomie in reducing the taste and odors. More recent work at the South District Plant confirms these experiences but indicates that there are definite limits to the effectiveness of these methods of treatment. Activated carbon is effective in removing detergents but tremendous quantities are required, which makes the cost excessive. There is also a dosage limitation. Coagulation with chlorinated ferrous sulfate and lime is effective within limits. Bentonite used with the usual coagulating agents has a limited effect. A cationic material such as a primary rosin amine is very effective but cannot be used in potable water supplies, as it is a strong skin irritant. (The effectiveness of the alum-silica treatment at the pH of 8.80 is presumed to be due in part to the cationic effect of alum at the higher pH.) Inert materials, such as finely ground silicon dioxide, and dolomitic limestone are completely ineffective. Precipitated calcium carbonate is quite effective. Partially settled sediment from the filtration plant sedimentation basins is very effective in removing detergents.

"Plotting the data from the carbon and settled sediment tests according to the Freundlich equation indicates that the removal of detergents from water is a surface adsorption phenomenon. The results from the Bentonite and precipitated calcium carbonate tests tend to confirm this."

New AWWA officers, installed during the meeting, are Frank C. Amsbary, Jr., Champaign, Ill., president; Paul Weir, Atlanta, vice-president; and William W. Brush, New York, treasurer. All are members of ASCE.

Inquiry Clears N.Y. Coliseum Builders

No evidence of criminal negligence was found in the collapse of the forms for an area of floor of New York's Coliseum three months ago (June issue, page 84, and July issue, page 33). An exhaustive two-month investigation by District Attorney Frank Hogan disclosed that the collapse was caused by "the inadequacy of the temporary supporting structure under the pressure of a horizontal or oblique thrust on the main exhibition floor." The report further stated that had there been "sufficient diagonal, horizontal and end-bracing . . . the collapse could have been prevented entirely or, at its worst, its area held to a minimum."

The thrust on the main exhibition floor was believed "created by the combined and sustained vibrations due to the movement and sudden stopping of the [concrete] buggies, the dumping of the concrete, the operation of concrete-agitating machines and the other activities on the floor."

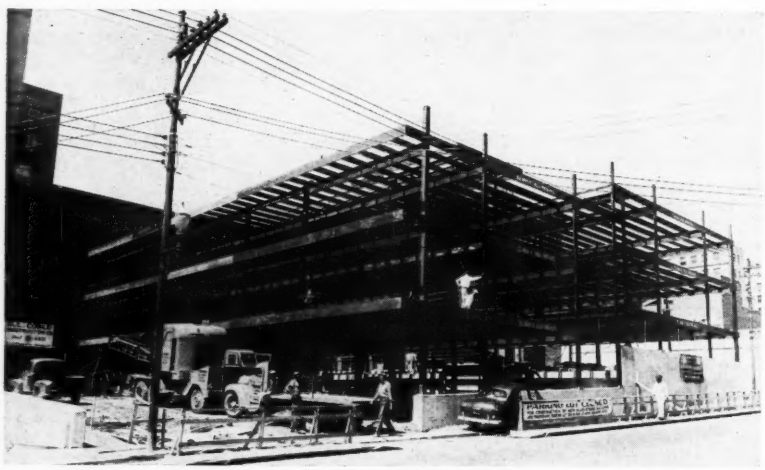
To what extent the accelerated construction schedule may have been a contributing factor is "an intangible quantity not susceptible of demonstration," the report stated.

Several significant recommendations were made by the District Attorney. Among these was the proposal that, "In reinforced concrete jobs, such as the Coliseum project the design of the temporary structure [falsework] should be drawn by a registered engineer or architect and filed with the Department of Housing and Buildings together with an affidavit stating that construction will be in compliance with the plan submitted."

Mr. Hogan also recommended that the qualifications required for building inspectors should be higher and that their number should be sufficient to handle the volume of work imposed on them. The report acknowledged the fact that "the presence of a properly compensated and trained graduate engineer on the job, whenever required, would have minimized the possibility of unsafe conditions.

The investigation was conducted by William H. Loguen attached to the Homicide Bureau of the District Attorney's office (one concrete laborer was killed in the accident) and John A. Farrell, a civil engineer in the District Attorney's office.

Open-Type Steel Parking Garage Features Novel Design



Open-type steel parking garage recently completed in Greensboro, N.C., incorporates several design innovations. The project consists of a pair of structures built next to each other on different levels. The floor levels in one unit are staggered midway between the floor levels in the other, permitting 50 percent shorter ramps and more parking space than the conventional one-level type. Overlapping floors provide another space-saving feature. The reinforced concrete slab on one floor is cantilevered over the floor below, giving the structure 3 ft 6 in. more width than a conventional structure built on a lot of the same width. There are eight parking levels—two on the ground floor and six supported decks—providing space for 256 cars (each accessible without moving any other car). Total cost of the project is about $137,000, or $535 per car space, said to be a record for the type of structure. The garage was designed by Watson & Hart, Greensboro consulting engineers, with the H. L. Coble Construction Co. the general contractor. Structural steel was fabricated by the Carolina Steel & Iron Co. and erected in thirteen working days by the Craven Steel Erecting Co. The owner is the Ellis-Stone Department Store.

Foreign Societies Greet ASME at 75th Meeting

Greetings of engineering and scientific organizations all over the world are presented to American Society of Mechanical Engineers during its 75th anniversary convocation held in Boston in June. Here, in usual order, are the Hon. Arthur Hartley, vice-president of Institution of Civil Engineers of Great Britain, who brought greetings from fourteen societies abroad; Dr. Warren Weaver, chairman of the board, American Association for the Advancement of Science, representing sixteen scientific societies in the U.S.; and Sir Vincent de Ferranti, chairman of the World Power Conference, who acted for four international engineering organizations.

AIEE Names New President

Morris D. Hooven, of Montclair, N.J., has been named 1955–1956 president of the American Institute of Electrical Engineers. Announcement of his election was made during the organization's seventy-first annual meeting held at Swampscott, Mass., in June. Mr. Hooven is with the Public Service Electric and Gas Co., Newark, N.J. The Lamme Gold Medal was presented to Aldo M. De Bellis, engineer with the Consolidated Edison Company of New York.

A. C. Monteith, current president of the AIEE, said that the electrical industry can be expected to double in ten years and to need twice as many engineers as now.

Huge Development Program Recommended for Syria

Recommendations for an economic development program for Syria—including public expenditures of about $530,000,000 in the 1955–1960 period have been drawn up by a ten-man mission organized by the International Bank for Reconstruction and Development. The report of the mission, which has been transmitted to the president of Syria, includes recommendations for expanded agriculture, industry, transport, and electric power.

Indicating that the development of means of transport is one of the country's most urgent needs and that road transport is best suited to the demands of the Syrian economy, the mission makes a number of recommendations for an improved highway system. It suggests new highways to link the agricultural area of the Jezireh with Aleppo, Syria's main commercial center, and Latakia, the chief port, and makes other recommendations for widening existing trunk roads and for improved road maintenance and traffic control.

The report shows the need for a considerable increase in electric power supply despite the fact that public utilities have been increasing their capacity in the past eight years. Total installed capacity amounted to 34,000 kw in 1953, and it is expected that it can be increased to 100,000 kw by the end of 1960.

ALCOA to Expand Its Davenport Works

Start of another phase of its three-year-old program for expanding its aluminum sheet rolling facilities at its Davenport, Iowa, works is announced by the Aluminum Company of America. This new step calls for installation of the widest hot sheet rolling mill ever designed and built for the aluminum industry, plus other supporting facilities. The 160-in. mill will permit the use of much larger ingots, making possible the wider aluminum sheet and plate required for modern aircraft and architectural and transportation uses.

Part of a continuous expansion program under way since 1952, the $20,000,000 mill marks the fifth major project in the nearly completed installation. More than $46,000,000 has been spent on the expansion program since 1952.

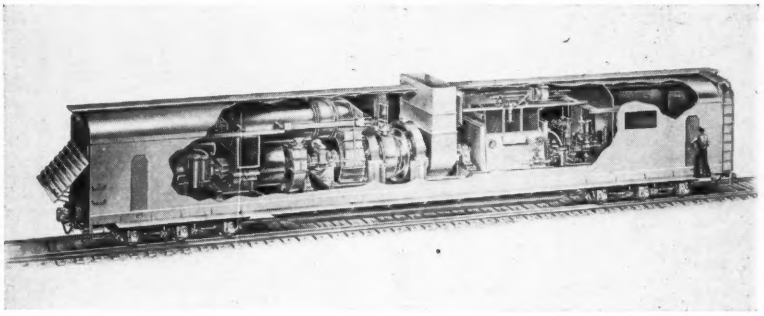
Mobile Power Plant of 5,500-Kw Built for U.S. Navy

Development of a mobile power plant of unique design, mounted on a single railroad car, has been announced by Clark Brothers Co. of Olean, N.Y., one of the Dresser Industries. This turbo mobile power plant, which can be placed in operation within 24 hours, is capable of developing 5,500 kw of electrical power rated at 80-deg F ambient temperature up to an altitude of 1,000 ft. Its source of power is a newly designed combustion gas turbine directly connected to a generator and capable of operation over a wide range of liquid and gaseous fuels.

Additional power is often needed at various shore stations of the Navy to meet emergency needs. Since duplicate standby services are entirely too costly to maintain, a mobile standby unit of substantial power output was considered to be the most economical solution. As a result, the Bureau of Yards and Docks established the general design requirements for a gas-turbine-driven power plant to be mounted on a railroad car, and Clark Brothers Co. was successful in bidding on the job.

Even though this is an emergency unit, it is of heavy duty design and can be operated continuously no matter how long the emergency may continue. The prime mover is a simple, open-cycle, dual-shaft, series-flow, gas turbine direct driving a two-pole synchronous generator.

Many interesting specifications were involved in the design. One was that the entire unit had to be contained in one railroad car of such size and design that it could be moved at high speed in any freight or passenger train on standard AAR-gage track without equipment damage. The only connections were to be to a fuel source and the transmission line. Water supply was not to be required.



Mobile power plant is completely self-contained in a single railroad car, requiring only connection to fuel and transmission lines. Cutaway shows Clark Turbo Mobile Power Plant mounted in a specially designed railway car. Opening on left end of the car is for air for lube oil coolers. Opening through roof in center of the car is for exhaust from the turbine. Starting at left are diesel engine used to start the unit, Clark gas turbine, generator, exciter, fuel pumps, and control room.

Corrugated Metal Used for Construction Tunnels at St. Lawrence Power Project

During the past winter tunnels were laid on prepared foundation in open trench, and were anchored against possible uplift by rods embedded in concrete foundation slab. Canal traffic was not interrupted.

Plate joints were waterproofed by using neoprene washers under nuts and bolt heads, by daubing all bolt heads with waterproofing compound, and by welding all seams both inside and out. Bolting operations were facilitated by use of air wrenches.

Two large corrugated metal tunnels have been built in open cut under Cornwall Canal for construction access to the Canadian side of Barnhart Island dam and power plant in the St. Lawrence River. An article in the November 1954 issue (page 33 et seq.) described the general plan for developing the St. Lawrence Seaway and Power Projects.

Contracts have been awarded for construction of the cofferdams enclosing the site of the Barnhart Island Dam and for construction of the dam and power station. Because water traffic on the Cornwall Canal is heavy, a bridge across it seemed impractical. Instead, during the past winter, when ice closed the canal to traffic, two access tunnels were laid in an open trench excavated across the canal. The larger tunnel, 16.5 ft in dia, provides a single lane with adequate clearance for the largest dump trucks; the smaller, 10 ft in dia, serves to carry a 48-in. belt conveyor for materials and a manway for workmen to pass through. Fig. 1 shows details of the concrete slab and crushed rock base on which the corrugated metal tunnels were laid. To resist possible buoyancy both tunnels are anchored to the concrete slab by bolts and embedded bars.

Portal-to-portal length of the tunnels is 368 ft, with 250-ft approaches at each end finished off with timber crib walls. Concrete diaphragms encircle each pipe at the canal bank line—100 ft each side of the canal center line—with sheetpile cutoff walls embedded and extending to the high-water line.

Work was carried out during the winter of 1954–1955 by the forces of the Hydro-Electric Power Commission of Ontario and by the Armco Drainage and Metal Products of Canada Ltd., which furnished the corrugated metal plates. During construction temperatures were down to 20 deg below zero for days without relief.

Pipe sections were assembled with bolts using neoprene washers under bolt heads and nuts, and all seams were welded inside and out. Air wrenches facilitated the bolting operations. Sections of the 10-ft tunnels were assembled in 100-ft lengths, the larger pipe in about 50-ft lengths. For placing, the lengths were bulldozed onto sleds, hauled to location by big tractors, and maneuvered into final position with two cranes.

After backfill was in place, the tunnel paving was laid, the interiors were painted with aluminum-pigmented paint, lighting and signal systems installed, and the belt conveyor installed in the smaller tunnel. Cofferdams and other obstructions in the canal prism were removed in April 1954, well in advance of water traffic.

Information and illustrations for this item were furnished by W. H. Spindler, editorial adviser, *The Highway Magazine*, published by Armco.

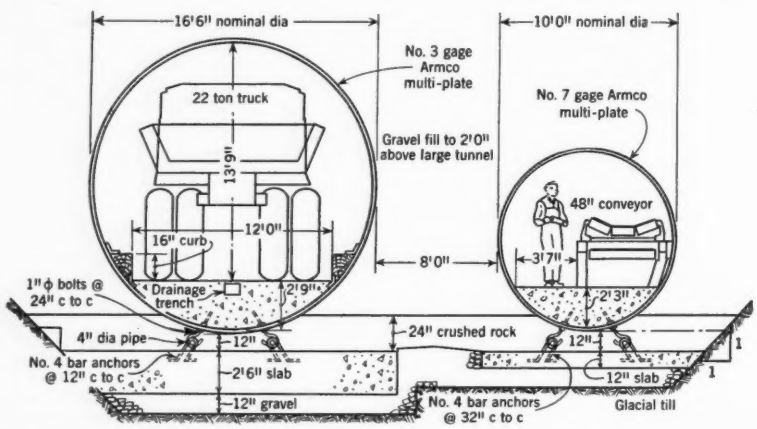


FIG. 1. Construction access from Canadian shore to Barnhart Island Dam and Power Station is provided by two corrugated metal tunnels under Cornwall Canal—one for large dump trucks, one for a belt conveyor.

INDIANA TOLL ROAD | Uses Armco Foundation Pipe

Driving Armco Foundation Piling for the Indiana Toll Road. This installation is a bridge project over the Sycamore Road, 10 miles northwest of South Bend, Indiana.

Rieth-Riley Construction Company, Inc.—General Contractors
Chapin & Chapin, Inc.—Sub-Contractors
J. E. Greiner Company—Consulting Engineers
Charles W. Cole & Son—Contracting Engineers
Pierce, Gruber & Beam, Inc.—Sub-Contracting Engineer

One of the newest expressways in the country is the Indiana East-West Toll Road, now under construction across northern Indiana.

In Sections C-24 and C-25, Armco Foundation Piling is being driven for a bridge foundation. This piling is 14″ O.D., in .188″ wall, with a design capacity of 30 tons. Many of these piles were actually driven over 60 tons capacity without difficulty. This is just one of six grade separations in these sections.

FOUNDATION PIPE FOR EVERY NEED

Few foundation pipe jobs are alike. But with Armco Pipe Piles, Caissons and Pile Shells to choose from—you'll find it easy to match almost any requirement. See table for sizes.

ARMCO FOUNDATION PIPE

DESIGN	PRODUCT NAME	DIAMETER O. D.	WALL THICKNESS	LENGTHS
	ARMCO PIPE PILES	8⅝″ to 22″	.141″ to .500″	Up to 93 feet
	ARMCO CAISSONS	24″ to 36″	.375″ to .500″	Up to 70 feet
	ARMCO HEL-COR PILE SHELLS	8⅝″ to 22⅛″	18 to 14 Gage	Up to 60 feet

For specific data on your foundation problems, write us. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 3955 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Workman welding cone points to the Armco Foundation Piling used on this project.

ARMCO®

ARMCO FOUNDATION PIPE

Three-Year Study of Engineering Education Released at ASEE Convention

Over 1,200 engineering educators gathered at University Park, Pa., for the 63rd annual meeting of the American Society for Engineering Education held June 20–24. Those who came to find out "what's new" in engineering education were not disappointed. The long-awaited Report on Evaluation of Engineering Education recommended some sweeping reappraisals of what constitutes adequate curricula in the light of our ever-expanding technology.

Summarizing the lengthy report of the Evaluation Committee, Dr. L. E. Grinter, chairman, said "The committee agrees with the basic concept expressed by industrial leaders that specific details of engineering practice change too fast to be of value for classroom study except as they may serve the high purpose of illuminating fundamental, unchanging principles. If this criterion is applied rather forcefully by engineering faculties, it is felt that opportunity will be found within the usual time limits to increase basic studies in science and the humanities."

The committee sees engineering education as contributing to "the development of men who can face new and difficult engineering situations with imagination and competence. Meeting such situations invariably involves both professional and social responsibilities." The committee considers that "scientifically oriented engineering curricula" are essential to achieve these ends and recommends the following means of implementation:

"1. A strengthening of work in the basic sciences, including mathematics, chemistry, and physics.

"2. The identification and inclusion of six engineering sciences, taught with full use of the basic sciences, as a common core of engineering curricula, although not necessarily composed of common courses.

"3. An integrated study of engineering analysis, design, and engineering systems for professional background, planned and carried out to stimulate creative and imaginative thinking and making full use of the basic and engineering sciences.

"4. The inclusion of elective subjects to develop the special talents of individual students, to serve the varied needs of society, and to provide flexibility of opportunity for gifted students.

"5. A continuing, concentrated effort to strengthen and integrate work in the humanistic and social sciences into engineering programs.

"6. An insistence upon the development of a high level of performance in the oral, written, and graphical communication of ideas.

"7. The encouragement of experiments in all areas of engineering education.

"8. The strengthening of graduate programs necessary to supply the needs of the profession, conducted in those institutions that can: (*a*) provide a specially qualified faculty, (*b*) attract students of superior ability, and (*c*) furnish adequate financial and administrative support.

"9. Positive steps to insure the maintenance of faculties with the intellectual capacity as well as the professional and scholarly attainments necessary to implement the preceding recommendations. These steps include: (*a*) well-established recruitment, development, and evaluation procedures, (*b*) favorable intellectual atmosphere, reasonable teaching loads, and adequate physical facilities, and (*c*) salary scales based on the recognition that the required superior faculty can be secured only by competitive remuneration, since professional practice in industry and government is inherently attractive to the best minds in engineering.

"10. The consideration of these recommendations at this time before the problems of educating greatly increased numbers of engineers become critical."

The three-year engineering evaluation project was financed by the Engineers' Council for Professional Development, the Engineering Foundation, the General Electric Co., and the National Science Foundation.

A broad study of two-year technical-institute education has been authorized by the ASEE. Nathan W. Dougherty, dean of engineering at the University of Tennessee and president of the ASEE, announced plans for the study, which will be made possible with an initial grant of $6,000 from Arthur Williston, former director of Wentworth Institute, Boston, and of the School of Design and Technology at Pratt Institute, Brooklyn.

In the annual election of officers Dr. Maynard M. Boring, consultant on manpower for the General Electric Co. and a long-time friend and supporter of the ASEE, succeeded Dean Dougherty as president. He is only the second representative from industry to be chosen president of the society.

ASEE honors went to Dr. Vannevar Bush, retiring president of the Carnegie Institution of Washington, who received the 1955 Lamme Medal for distinguished service in engineering education. Robert R. White, professor of chemical engineering at the University of Michigan, received the 1955 George Westinghouse Award as "an outstanding young engineering teacher."

NUCLEAR NOTES

XIII—Preparation of Samples for Assay

This installment of "Nuclear Notes" was prepared by Bernd Kahn at the request of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy. Mr. Kahn is Assistant Sanitary Engineer, Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, currently assigned to the Oak Ridge (Tenn.) National Laboratory. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which also includes Earnest F. Gloyna, A. E. Gorman, Prof. Warren J. Kaufman, Alexander Rihm, Jr., and James G. Terrill, Jr. Next month's subject will be: Identification of Radioisotopes by Relative Counting Techniques.

Counting of radioactivity involves a choice of counter and of sample preparation, the two being related to some degree. The various counters used have been described in Nuclear Notes X and XI; some aspects of sample preparation will be discussed in this summary.

The method of sample preparation employed is a function of the radiation to be detected, the counter available, and the type of sample submitted for counting. Much counting is relative, that is, only a comparison of count rates is desired, rather than absolute, which involves the determination of disintegration rates.

In relative counting it is of extreme importance to have all samples treated identically; the counter, relative position of counter and sample, and sample preparation must be the same. The kind of sample used will depend on whether alpha particles, electrons or beta particles, or X or gamma rays are to be counted. The absorption of these radiations decreases in the order named and depends to some extent upon the energy of these radiations. With the exceptions cited below, samples prepared for alpha counting must be almost weightless, those for beta counting should be very thin, and those for gamma counting may be several centimeters in thickness. If this condition of sample thickness as related to kind of particle or ray being counted is not observed, a large fraction of the radioactivity distributed throughout the sample will be absorbed within the sample and will not be detected by the counter. The fraction lost increases with the thickness of the sample. For alpha and beta counting the samples should be kept as small as possible in accordance with the activity present. Where it is necessary to add carriers, their weight should be under 20 milligrams. If large amounts of solids are present in the original sample, a chemical separation may be required. In any counting, uniformity of sample deposition is important. Some

Bitumuls Black Seal puts new life in city streets

Bitumuls Black Seal, consisting of a single application of Bitumuls emulsified asphalt, puts new life in weathered pavement surfaces.

Merced, California, treats 140,000 square yards at cost of $1050

A recent survey of residential streets in one section of Merced, California, indicated that the paved surfaces were starting to deteriorate at an alarming rate. Some were streets originally built of concrete and later resurfaced with a one-inch asphalt plant-mix overlay. Others were plant-mix surfacing on a rock base.

For those surfaces that were seriously cracked, broken or ravelled, specifications were drawn up calling for Bitumuls® Surface Treatments (either Single or Double, with chip-cover).

Preventive Maintenance Indicated

On many of the streets, however, the surfaces while still in relatively good condition were oxidized, dry and open-textured. The Engineers realized that unless some form of "preventive maintenance" were undertaken, these surfaces would soon require extensive repairs and possibly complete resurfacing. What they needed was a method of revitalizing these surfaces, plus the placement of additional binder to seal the interstices against water damage.

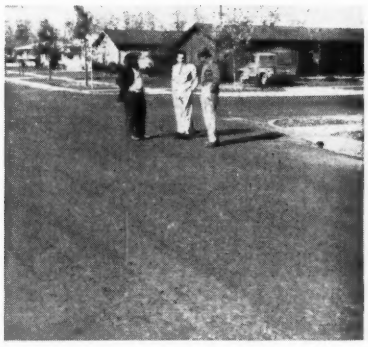
Bitumuls Black Seal Selected

After investigating several proposed methods, the Engineers decided on the use of Bitumuls Black Seal to rectify the situation. For this work 0.1 gal. per sq. yd. of (1:1) diluted Bitumuls SS-2 emulsified asphalt was applied to the surfaces. No cover was used. This treatment provided the necessary binder to adequately seal the pavement, and the coating was thin enough on the high spots to prevent pick-up under traffic which was allowed over the pavement within one hour.

Adaptable To Wide Application

Costs of the Black Seal work and for the other Bitumuls Surface Treatments are given in the table below.

Dry and open-textured paved surfaces are not peculiar to Merced. This method of economically extending pavement life merits investigation by communities in every part of the country. *Specifications on Black Seal, and on Bitumuls Surface Treatments, are available on request.*



Engineers of Merced and Fresno, California, inspect pavement to be revitalized.

Before. Here is a representative dry, weathered surface for which Engineers of the City of Merced recommended Bitumuls Black Seal.

After. Notice the tight, uniform texture obtained by a single Black Seal application. No tendency toward fatness or bleeding.

COST SUMMARY

ITEM	I Black Seal	II Single Chip Seal with Black Seal	III Double Chip Seal with Black Seal
Labor (including Rock Haul)	$210	$168	$602
Bitumuls RS-1 at 10c per gal.		160	829
Bitumuls SS-2 at 11c per gal.	840	90	396
½" Crushed Rock at $2.35 per ton			668
⅜" Crushed Rock at $2.35 per ton		151	
¼" Crushed Rock at $3.35 per ton			450
Total Cost (labor & materials)	$1050	$569	$2945
Total Square Yards	140,000	6240	16,090
Cost per square yard (labor & materials)	$.0075	$.0913	$.183

Note: Cost does not include equipment rental.

AMERICAN Bitumuls & Asphalt COMPANY

200 BUSH STREET · SAN FRANCISCO 4, CALIFORNIA

E. Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Mobile, Ala. Cincinnati 38, Ohio Columbus 15, Ohio Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La. St. Louis 17, Mo. Inglewood, Calif. Oakland 1, Calif. Portland 7, Ore. Washington 5, D. C. San Juan 23, P. R.

investigators have gone to great lengths to insure uniformity of distribution through the use of specially grooved sample containers, filter paper in the bottom of the container, or very gentle heating.

Liquid samples are usually pipetted on to thin films, metal plates, shallow metal or ceramic dishes, or watch glasses in volumes to give a good count rate. Metals such as steel, aluminum, copper, and platinum have been used as sample containers; the kind of material used depending on the chemical composition of the solution being counted, the importance and permanence of the sample, and on the count rate, since the radiation backscattered into the counter depends on the atomic number and thickness of the backing material (sample container). The liquid is evaporated to dryness under infrared lamps or other gentle heating device before counting. If large volumes must be concentrated to give a satisfactory count, an automatic pipetting device which adds a few drops at a time to the sample being dried may be used. In the case of alpha counting, the dried sample may be flamed before counting to destroy any organic material present and reduce self-absorption losses. Volatile nuclides may be lost upon heating and must be converted to non-volatile forms before heating. This holds true for radionuclides of hydrogen, carbon, chlorine, technecium, ruthenium, osmium, teilurium iodine, and mercury. No chemical conversion is available for the noble gases. The volatility of these radionuclides is sometimes used to obtain thin uniform samples by evaporating them and depositing them on cooled disks. Similarly, radionuclides may be deposited from solution by electrodeposition.

Following radiochemical separation, the precipitate available for beta counting weighs possibly 2 to 20 milligrams. This precipitate is usually filtered through a small filter paper or crucible, dried by heating or washing with ether, and counted on the paper or crucible. Other solid samples, to be counted without chemical separation, may be ground or ashed, spread manually or slurried on a counting dish, and dried. Here again the problem of sample thickness arises since the radioactivity may be emitted from an atom located on or somewhere below the surface and consequently may or may not be absorbed.

If only one radionuclide is being counted, the problem of self absorption may be alleviated by counting "infinitely thick" samples. All commonly encountered alpha and beta particles are absorbed in 0.02 gm/cm² and 2 gm/cm² of aluminum, respectively, and their absorption in other materials is of the same order of magnitude. By counting samples having at least these respective surface densities and equal surface areas, count rates proportional to the concentration of the radionuclide present are obtained. This principle may be employed with solid and liquid samples, the latter being preferred because of their homogeneity. In the absence of "infinitely thick" samples, samples having the same weight and spread over the same area can be counted and compared.

Unless too large a fraction of the radiation will be absorbed, it is always advisable to seal the sample by covering it with a thin film of polystyrene or some similar material. In this way, loss of sample, as well as an increase in the weight, such as occurs with hygroscopic precipitates, is prevented.

Many of the problems inherent in alpha and beta counting can be avoided if the radionuclide under study emits gamma rays, which can be counted in a scintillation counter provided with a gamma detecting crystal. Samples several centimeters in diameter or larger can be counted directly without solution, evaporation, grinding, or slurrying.

The radiations of some radionuclides, such as carbon-14, hydrogen-3, and the noble gases (krypton, xenon, and radon), can be detected more readily when the substances are in gaseous form. Substances containing radioactive carbon or tritium are destroyed to obtain CO_2 or H_2 gas, respectively, while the noble gases are absorbed on charcoal or other material prior to being combined with the counter gas and counted with a minimum of self absorption.

R. ROBINSON ROWE, M. ASCE

"It looks," mused Professor Neare, "as if I could take it easy tonite. Cal Klater's on deck with a smirk on his face, Joe Kerr's recovered his youthful freshness and I have a Guest Professor. Ike, nothing can possibly go wrong."

"I hope you're right," said Guest Professor Eichenspufem. "Even Cal can relax if Joe's freshness means that he didn't leave the blocks-in-box problem until the last minute."

"I started the first night," echoed Joe, "because it was the answer to our problem of getting little Fay to bed. She likes TV better than playing with blocks, but she's game for any kind of game. So I set up the 36 blocks in the 11 step-like piles, explained the rule about taking all or any part of a pile in each play and the other rule about the last player going right straight to bed, and made the first play by putting away the middle pile of 6 blocks.

"Well, she took a block from a 5-block pile and I put away the other 5-block pile. Obviously she was using delay tactics; it was my strategy to reduce the spread to 3 piles quickly and then outwit Fay in the end play. We had started at 8:15; at 8:20 we were down to 3 columns with 1, 2 and 3 blocks respectively and it was my play with 6 choices. Shrewdly I stowed away the 3-block pile, but she crossed me by taking 2, and at 8:22 I was in bed.

"Naturally Fay loved the game, so she insists on playing every night. Always we reach the 1, 2, 3 at my play. I tried the other 5 choices and always landed in bed, begrudging Fay my easy chair facing the TV. In desperation I called Cal, and he gave me the smart idea of making Fay play first. Now I get to bed at 8:21. The extra sack-time this past month may make me look fresh, but I don't like it. If I could beat Fay just once she'd stop."

"Then you'd better play first," advised Cal Klater. "I put the other idea in your head for a joke, thinking you'd give up after a couple of tries. But if your first play takes the 6-block pile you leave the symmetrical array 1-2-3-4-5-5-4-3-2-1 and if you always match Fay's play you can always restore symmetry. Eventually there will be an even number of 1-block piles and a pair of larger but equal piles. That pair must reduce to 0-1 on your play, so keep your eye on it. If Fay reduces one of the pair to a 1-block pile, you take all of the other, and vice versa, but you continue to match any other play. That way you will finally leave an odd number of 1-block piles, putting Fay to bed."

"And high time for her, too," concluded the Guest Professor. "Cal's tactics are perfect for an array which can be made symmetrical. Binary arithmetic furnishes an elegant solution applicable to any array; it may help you solve the sequel Noah has in mind."

"The sequel," said Professor Neare, "is to give Joe another chance. Suppose he plays first at 8:15, that Fay learns the hard way that he can win, that she stalls on each play, and that he sets a time limit. Suppose this time limit is 5 sec per play plus a bonus for Fay of 1 sec for each pile she has to choose from. How soon can Joe surely send Fay to bed?"

[*Cal Klaters were H. Francis Finch, Thatchrite (Guy C. Thatcher) and Richard Jenney. Guest Professor Eichenspufem is still Ed C. Holt Jr. President Glidden, who claims he reads every word in "Civil Engineering," wrote that he found the two along the left edge of Fig. 1.*]

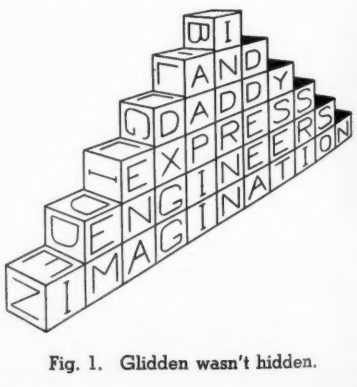


Fig. 1. Glidden wasn't hidden.

Construction Boom Aids Puerto Rican Economy

Construction in Puerto Rico has taken vast strides in the past fifteen years, with resultant benefit to the economy of the country, according to the Economic Development Administration. In fiscal 1953–1954, more than 8,000 construction projects, with a value of more than $56,000,000, were carried out. This was four times the number and ten times the value of 1940 projects. Construction of new factories, homes, and highways has been particularly active.

In the past five years more than 300 new plants or plant expansion projects have been attracted to the island by the favorable federal income tax situation, 100 percent local tax exemption, the availability of multi-purpose plants on government lease and other incentives. Industry there today has an investment of about $115,000,000 in buildings and machinery.

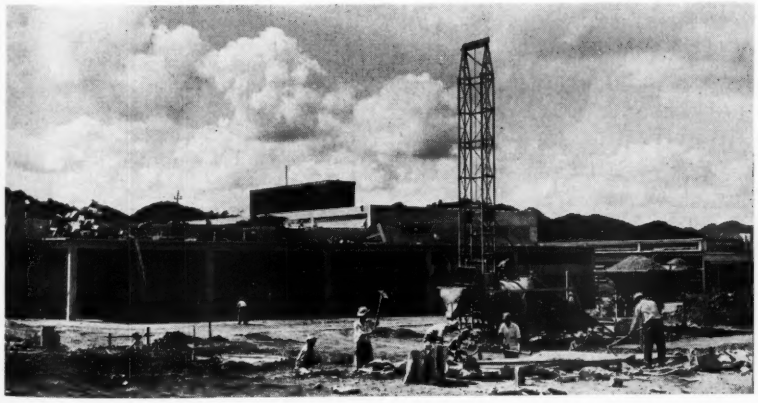
Since World War II more than $147,000,000 has gone for construction of apartment buildings and single- and multiple-family units. Major developments include the $10,000,000 Los Lamos Project currently under construction. This project will accommodate 2,000 families.

The island has one of the most modern highway systems in the world, with one mile of paved road for every square mile of land area. Between the end of the war and 1955, federal funds earmarked for Puerto Rican roads amounted to $29,000,000. To match these funds, the commonwealth has appropriated $32,000,000 along with $18,000,000 for municipal roads and $4,700,000 for repair and reconstruction.

Other projects swelling the construction boom are the recently completed $15,000,000 International Air Terminal near San Juan; the $11,000,000 Caribbean Oil Refinery (Puerto Rico's first), currently being built; and numerous schools, hospitals, hydroelectric projects, and harbor facilities.

The Economic Development Administration notes that, since 1940, total income has more than quadrupled—to $1,000,000,000, the most rapid increase in any country in the world. During the same period imports from the mainland have skyrocketed 384 percent to $500,000,000 a year, making the island Uncle Sam's best customer.

A number of the new construction projects will be visited by members of ASCE making the President's Post-Convention Inspection Trip to Peurto Rico in October. Details of the trip are given in the Society News lead item.



Caribbean Oil Refinery (upper photo), first to be built in Puerto Rico, is going up at a cost of $11,000,000 on a 175-acre tract across San Juan Harbor from the city itself. Crude oil brought from Venezuela will be processed at the refinery, which will have daily capacity of 10,000 bbl. In lower view workmen add finishing touches to new industrial plant built by the Puerto Rico Industrial Development Co. for the Vega Alta Corp.

You are cordially invited to join

THE PRESIDENT'S INSPECTION TOUR TO SAN JUAN, PUERTO RICO

Oct. 28-Nov. 2

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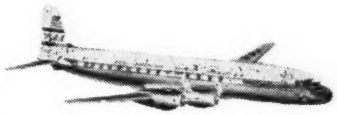

An interesting, exciting 5-day itinerary planned by the Puerto Rican Development Board, the Puerto Rican Section of A.S.C.E. and Pan American World Airways.

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Round-trip First Class transportation via PAA, accommodations at the famed Caribe Hilton for four nights, round-trip transfers from airport to hotel, sightseeing trip in San Juan, local engineering inspection trips and other features especially arranged by the committee.

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A pair of Flex-Plane Finishers at work on the eastern end of the Ohio Turnpike.

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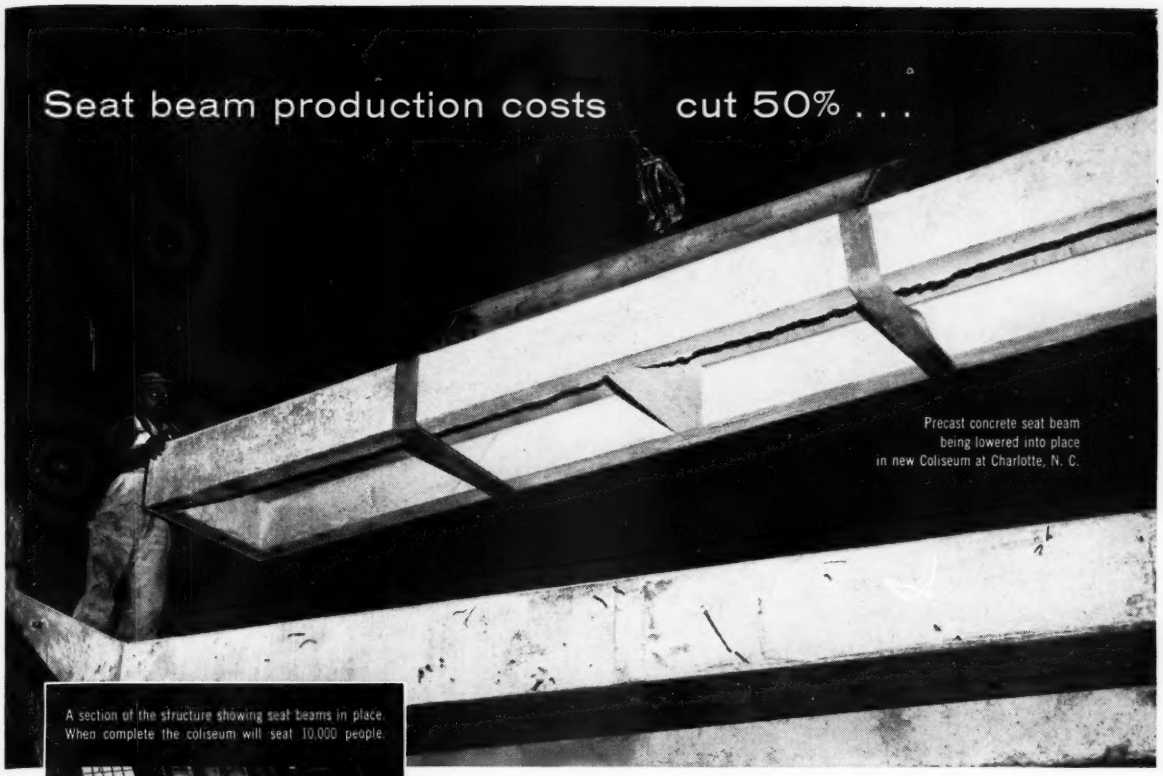

Precast concrete seat beam being lowered into place in new Coliseum at Charlotte, N. C.

A section of the structure showing seat beams in place. When complete the coliseum will seat 10,000 people.

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▲ John Hancock Building, Boston

The 26-story John Hancock Mutual Life Insurance Building in Boston rests on 1567 H-piles, varying from 88 to 120 ft in length and driven to bed rock. *Architects and Engineers:* Cram and Ferguson, Boston; *General Contractor:* Turner Construction Co., Boston and New York; *Piling Contractor:* Raymond Concrete Pile Co., Boston.

Veterans Hospital, New York City

The 19-story Veterans Medical and Surgical Hospital in New York City rests on 2600 tons of steel H-piles. *Architects:* Alfred Hopkins and Associates; *General Contractor:* Cauldwell-Wingate Co., both of New York. *Piling Contractor:* I. B. Miller Contracting Co., Long Island City, N. Y.

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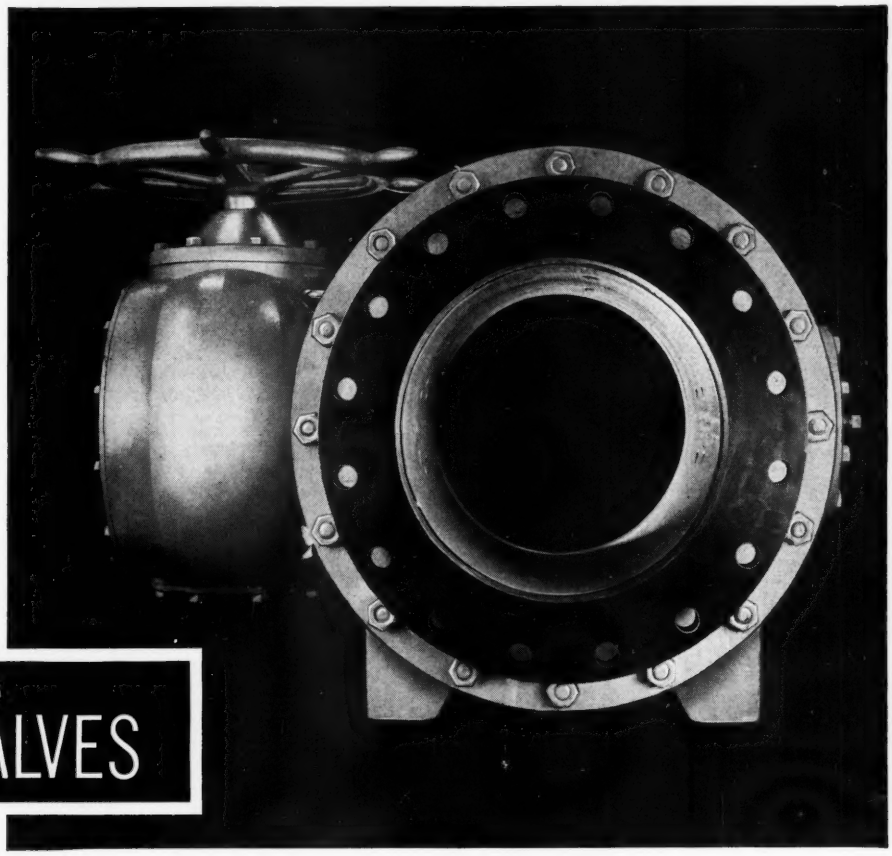

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DECEASED

Robert Moore Angas (M. '29), age 68, since 1924 senior partner in the Jacksonville, Fla., firm, Robert M. Angas & Associates, died June 21. A 1907 graduate of the Georgia School of Technology, Mr. Angas worked for the Indian River Association, Ltd., Hobe Sound, Fla., before serving as first lieutenant with the U.S. Army Engineers in France in World War I. Upon discharge he became mill manager for Chase & Company, Loughman, Fla. As a consultant Mr. Angas worked for various suburban developments in Florida, the U. S. Navy and the Department of Justice on land acquisition cases.

Albert Edward Cummings (M. '36), age 61, for the past eight years director of Raymond Concrete Pile Company, Chicago, Ill., died of a cerebral hemorrhage in New York City on July 20. Mr. Cummings, a specialist in foundations, spent all his professional life with Raymond, being successively field clerk, field superintendant, district manager in Chicago, and, most recently, director of research. A graduate of the University of Wisconsin, class of 1915, Mr. Cummings was awarded a C.E. degree by his alma mater in 1922. For thirty years he took an active part through national and international engineering societies in the development and practical application of the science of soil mechanics and recently participated in the development of practical codes for the design and construction of prestressed concrete structures. He is the author of many articles and has lectured on foundation engineering at Harvard, the University of Illinois and Cornell.

A. E. Cummings

Joseph Ricker Guptill (A.M. '21), age 64, construction material sales engineer with Columbia-Geneva Steel Division of U.S. Steel Corporation, San Francisco, Calif., died May 16. After service in the U.S. Army Engineers in France in World War I, Mr. Guptill worked as structural engineer for various companies in California—the Cope, Rand, Means Company, and Ford, Bacon & Davis. For many years he was engineer with Pacific Gas & Electric Company in San Francisco. Mr. Guptill graduated from St. Mary's College in Oakland in 1914.

William Dewoody Dickinson, Former Director, Dies

William Dewoody Dickinson (M. '17), age 73, Director of District 14 from 1942 to 1944 and an active organizer of the Mid-South Section, died in Little Rock, Ark., on June 15. An engineering student and graduate in law of the University of Arkansas, Mr. Dickinson's early career was in work with the U.S. Geological Survey and with railroads. A Little Rock consultant for the past 46 years, in 1909 he organized the engineering firm of Dickinson & Watkins, which, in 1926 was reorganized as Dickinson & White, Engineers, Inc. During this time his assignments included work for the City of Little Rock on its airport, the sanitary sewer system at Camp Pike, and the water works and sanitary sewer systems at the picric acid plant near Little Rock. In addition to his duties as head of his engineering firm, Mr. Dickinson for over forty years was chief engineer in charge of flood control for the Plum Bayou Levee District in Pulaski, Lonoke and Jefferson Counties in Arkansas. He was active in the preparation and passage of the Arkansas engineer registration law.

W. D. Dickinson

(*Continued on page 96*)

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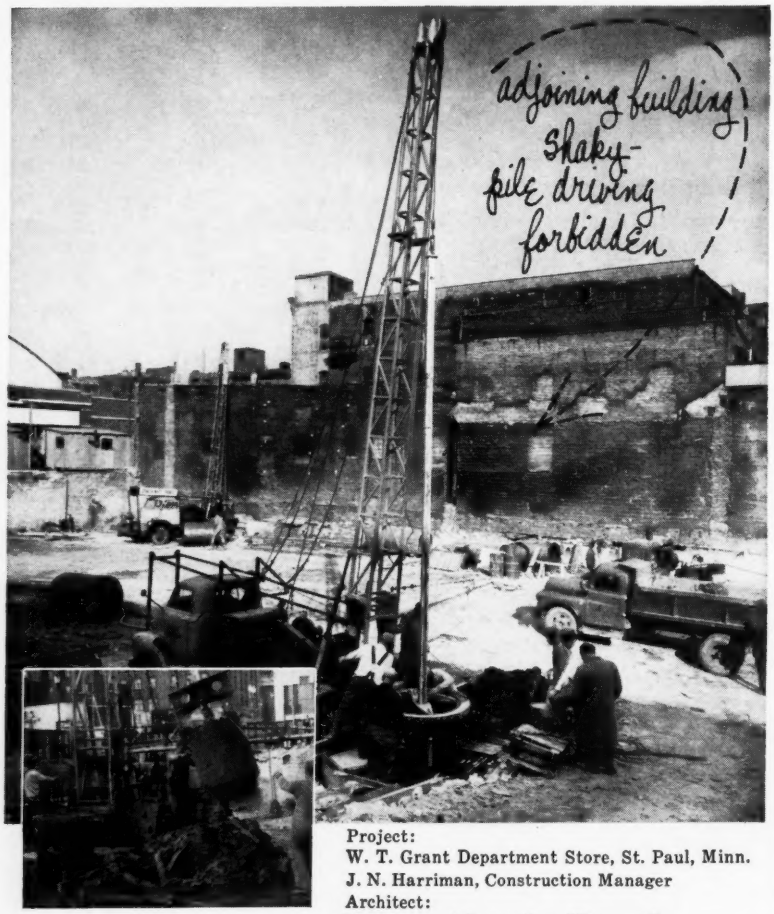

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Deceased

(*Continued from page 94*)

Allan Stacey Hadley (M. '27) age 71, of Long Beach, Calif., died on June 10. After experience with various railroads and bitulithic paving companies in Texas, Mr. Hadley worked from 1926 to 1938 for Warren Brothers Company of Boston, Mass. Starting as engineer representative for work with the Nippon Oil Co., Ltd., of Tokyo, he later did company promotion in Central America and from 1929 to 1938 was president of the Guatemala branch. Mr. Hadley from 1936 to 1938 was also president and director of Standard Bitulithic Co., New York, and vice-president of Warren Finance Corporation, Boston.

Edwin Francis Halloran (A.M. '26), age 68, consulting engineer of San Francisco, Calif., died on May 28. Educated at Stanford University, Mr. Halloran joined the Spreckels Sugar Company of California in 1908, becoming civil engineer in charge of engineering in 1915 and consulting engineer in 1920. In 1925 he became president and consulting engineer of the Cement Gun Construction Company in San Francisco, Calif., which he served for many years. Mr. Halloran later practised in Belvedere, Calif.

Earl Edgerton Hellener (A.M. '45), age 63, since 1918 engineer for Atchison, Kans., died on April 28. Educated at the University of Kansas, Mr. Hellener joined the Atchison Engineering Department in 1914 and became assistant city engineer in 1916. He also served from 1927 to 1945 as assistant city manager and later was acting city manager.

John Raymund Hoffert (M. '26), age 70, recently retired chief engineer of the Pennsylvania Department of Health, Harrisburg, and member of the department since 1919, died on June 4. Mr. Hoffert had previously worked for the Pennsylvania Steel Company, the Harrisburg Park Commission, and was progress engineer for construction of Edgewood Arsenal in Maryland. Serving as an officer of the State Sanitary Water Board from 1927 to 1946, he helped launch its Clean Streams Program. Mr. Hoffert graduated from Cornell University in 1911.

Lemuel Holmes (M. '10), age 81, retired New York State Civil Engineer, died in Loudonville, N.Y., on June 13. Mr. Holmes joined the engineering department of the New York State Highway Commission in 1904 and later held the position of assistant engineer, senior engineer, and finally civil engineer. He graduated from Rensselaer Polytechnic Institute in 1898.

Edward Albert Kemmler (M. '19), age 86, who retired in 1941 as special engineer with the Akron, Ohio, County Engineer's

(*Continued on page 100*)

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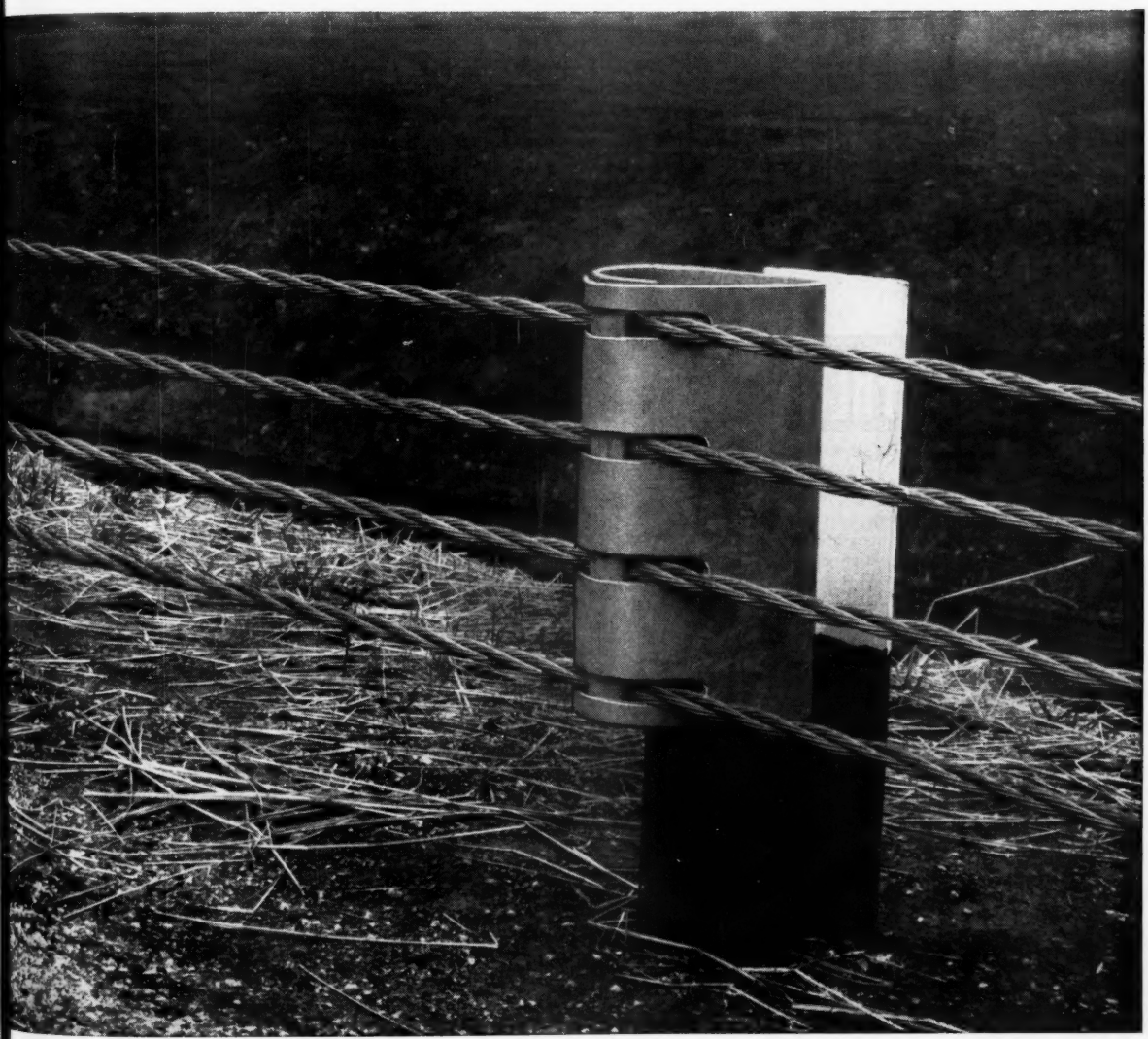

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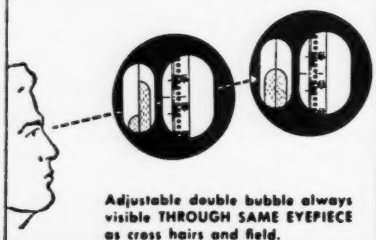

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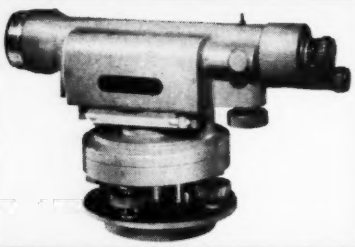

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☐ Theodolites ☐ Repair of present instruments, (any make)

NAME.....

ADDRESS.....

.....

Deceased

(*Continued from page 96*)

Office, died in Columbus, Ohio, on May 19. Following graduation from Ohio State University in 1888, Mr. Kemmler taught there for four years. The following thirty years he was assistant city engineer for Columbus, supervising municipal engineer for Muskogee, Okla., and water works and highway engineer for Akron. He was director of Akron's Public Service in 1931, 1934 and 1935.

Neil McIntyre Loney (M. '21), age 79, industrial consultant of Huntington Woods, Mich., died last November. A graduate of Armour Institute of Technology, class of 1897, Mr. Loney began his career with the Pennsylvania Railroad and from 1906 to 1919 was chief engineer of American Can Company. After six years as vice-president of the Thompson Starret Company in New York City, in 1925 he joined the Fisher Body Division of General Motors, Detroit, Mich., serving successively as general assistant, manager of motor transportation, and chief works engineer.

Rollin Fay MacDowell (M. '23), age 68, head of the consulting sanitary engineering office, Rollin F. MacDowell & Associates in Cleveland, Ohio, since 1925, died on May 25. A graduate of Ohio State University, Mr. MacDowell was assistant engineer in the Ohio State Department of Health at Columbus from 1909 to 1913, and from then until 1920 was assistant engineer with R. Winthrop Pratt, consulting engineer of Cleveland.

Gustave Paul Magnel (M. '47), age 65, Belgian consultant, professor, and inventor of the Belgian system of prestressed concrete construction, died in Ghent on July 5. A graduate of the University of Ghent, class of 1912, Professor Magnel had been on the faculty of the university since 1919 and professor since 1927. Previously he had been assistant and then chief engineer for D.G. Somerville & Company in London. Professor Magnel designed the Walnut Lane Bridge in Philadelphia, the first prestressed concrete bridge in this country. A writer of numerous publications on reinforced and prestressed concrete, he was a member of the Royal Academy of Belgium from which he received the Lemaire Prize. Among the awards conferred upon him were the Frank P. Brown Medal of the Franklin Institute of Philadelphia and the Grand Medal of the Association of Doctor-Engineers of France.

G. P. Magnel

(*Continued on page 102*)

Did you know that

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can serve you by air mail and air parcel post? Over 170,000 engineering texts, and files of every worthwhile periodical are available for further research to meet your specific needs—patents, design, research, construction, and management problems. Charges cover only the cost of the services and represent but a fraction of the value you will receive.

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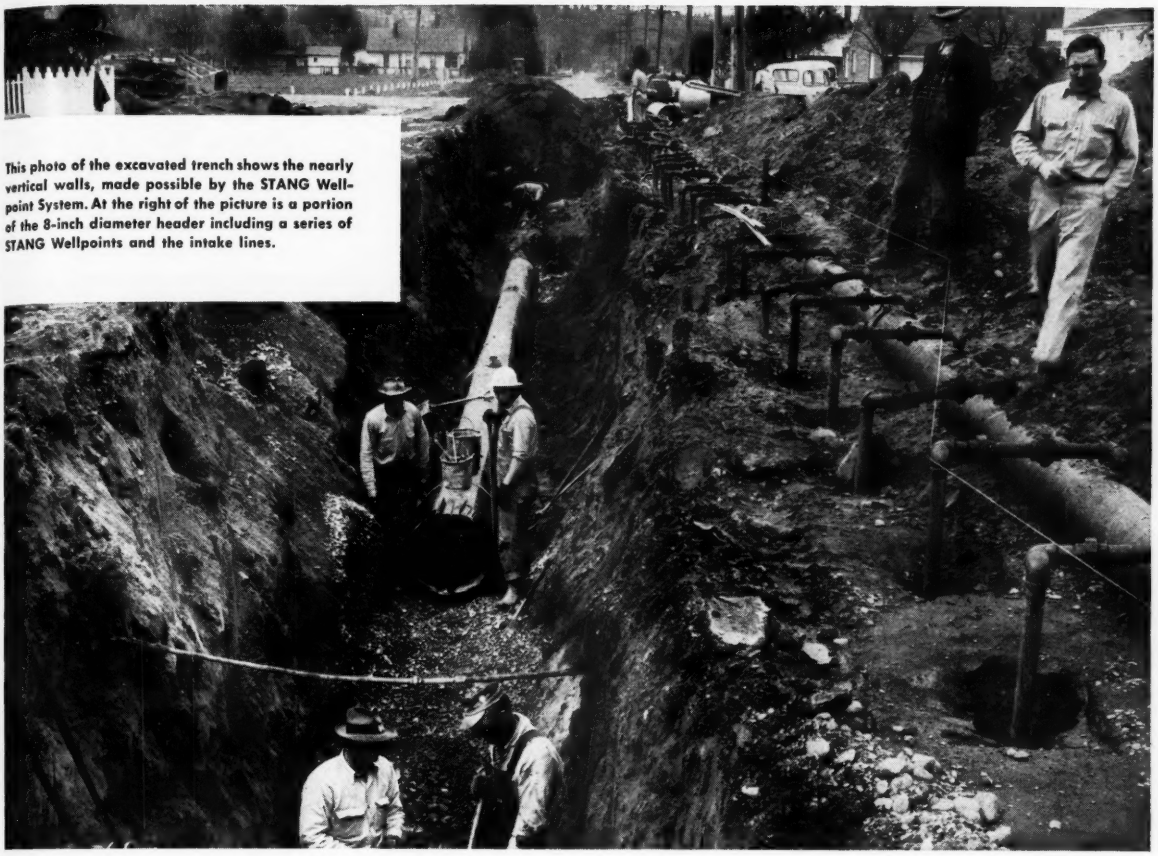
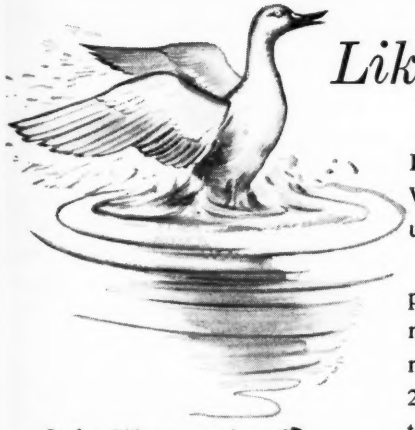


This photo of the excavated trench shows the nearly vertical walls, made possible by the STANG Wellpoint System. At the right of the picture is a portion of the 8-inch diameter header including a series of STANG Wellpoints and the intake lines.



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At Puyallup, Washington, a particularly tough assignment was completed by STANG. Unwatering this sewer trench at Puyallup proved to be no easy job... quicksand and mud presented a real problem. STANG engineered and installed a Wellpoint System, enabling the contractor to lay 200 feet of 48-inch pipe per day in a completely dry, 6½-foot by 9-foot trench without danger of uplift, "boils" or sloughing.

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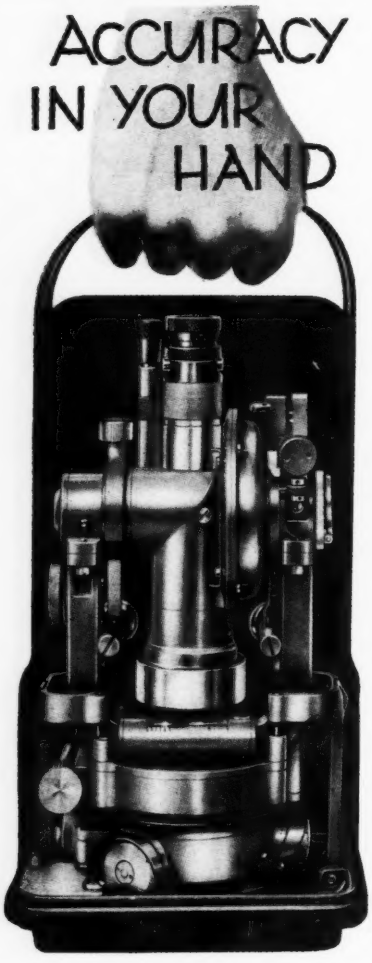

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(*Continued from page 100*)

John Rowe Newell (A.M. '21), age 69, president of the Mid West Concrete Company, Evanston, Ill., died last December. Mr. Newell had been associated with the company since the thirties and previously had been vice-president and sales engineer with the Illinois Concrete Sales Company, Chicago, and manager of the Spokane Concrete Pipe Company, Spokane, Wash. He graduated from the Minnesota School of Mines in 1910.

William Nickels Patten (M. '10), age 86, retired vice-president of Stone & Webster Engineering Corporation, Boston, died in Salem, Mass., on June 8. Associated with the firm for fifty years until his retirement in 1949, Mr. Patten was also consultant to the Japanese Government for hydroelectric development from 1928 to 1934. He graduated from the University of Maine in 1891.

Walter Sherman St. John (A.M. '14), age 72, structural engineer of New York City, died on June 20. Associated with various New York firms early in his career, Mr. St. John was assistant engineer with the New York Central Railroad in the early thirties and served as assistant engineer with the New York City Board of Water Supply from 1938 to 1941. He had been structural engineer with Madigan-Hyland, Long Island City, N.Y., since 1949 and had worked on design of the cantilever and support framing for the United Nations buildings and on the buoyant concrete foundations for Tappan Zee Bridge over the Hudson River.

William Henry Smith (A.M. '24), age 79, consulting engineer of Jefferson City, Mo., died last December. Mr. Smith did private contracting and engineering work in New York and Boston from 1900 to 1911 and then worked on investigations for oil sources, sulphur and plant locations in the United States, Mexico, China and Japan for banks and oil companies. Since 1923 Mr. Smith had practiced in Louisville, Ky., St. Louis and Jefferson City, Mo. During the war he was locality expediter for the Northeast Section of the National Housing Agency.

John Theodore Tobin (M. '48), age 70, with the Gulf Smokeless Coal Company, Tams, W. Va., since 1921, and chief engineer since 1941, died on January 15. Following graduation from Massachusetts Institute of Technology in 1908, Mr. Tobin worked for the Virginia Railway Company in Norfolk. In 1914 he joined the Interstate Commerce Commission, Bureau of Railroad Valuation, Washington, D.C., as structural engineer and then was construction engineer and later division engineer for Bethlehem Steel Company's division in Sparrows Point, Md.

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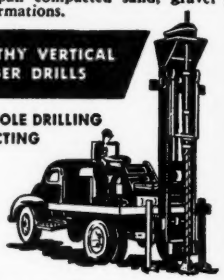

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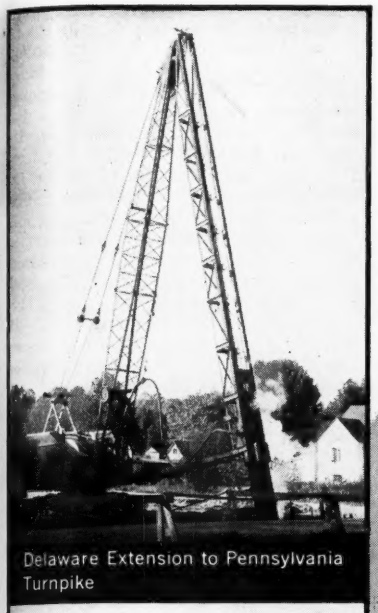
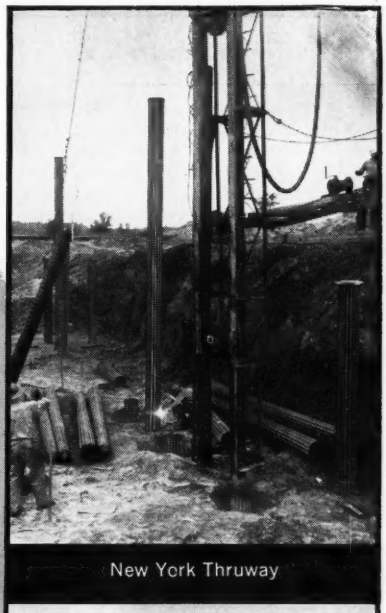


Delaware Extension to Pennsylvania Turnpike



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On-the-job extendibility to virtually any required length, quick cut-offs and ease of handling are additional Monotube features that help builders and contractors save time and money on a wide range of foundation jobs. Write today to The Union Metal Manufacturing Company, Canton 5, Ohio.

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New in Education

New Courses. University of California's Institute of Transportation and Traffic Engineering is holding an eight-week summer graduate program in highway engineering. Designed to improve teaching in this field, the course has an enrollment of twenty-seven engineering college instructors . . . . . Two graduate courses in Nuclear Engineering will be given at Oklahoma A. & M. College this year. Under the chemical engineering department, the first will be an introductory course, the second will include power generation, industrial problems and research . . . . . The Prestressed Concrete Institute and the University of Florida have organized a three-day short course on prestressed concrete. It will be held at the Maritime Base, St. Petersburg, Fla., October 10–12. Registration fee is $25.00 including course and luncheons. Further details from the University of Florida, Gainesville . . . . . Nightly review courses for the February examinations for the New York State Professional Engineer License will be given by the N.Y. State Society of Professional Engineers. Scheduled in three parts starting September 7, they will be held at the Brooklyn Union Gas Co., 176 Remsen St., Brooklyn. For further information write S. S. Aidlin, Chairman of Education Committee, Kings County Chapter, NYSSPE, 117 Remsen St., Brooklyn . . . . . A course in building department administration was held this summer at the University of Southern California under the sponsorship of the university and the Pacific Coast Building Officials Conference. The sixty building officials developed their own course in a series of workshops covering all phases of building codes and their administration.

Scholarships, Fellowships and Grants. The National Science Foundation has announced a second postdoctoral fellowship award period for this year. The fellowships, for advanced study and training, have a stipend of $3,400 a year. Applications, open through September 12, should be sent to National Science Foundation, 2101 Constitution Ave., Washington 25, D.C. Awards will be announced October 20 . . . . . To encourage the study of civil engineering and ease the shortage of graduate civil engineers, the Asphalt Institute has created the first Bernard E. Gray Fellowship. The fellowship, named for the past-president of the Asphalt Institute, is in asphalt technology at the University of Maryland and is the first of several to be established . . . . . First award of a graduate fellowship in civil engineering recently established at Illinois Institute of Technology by the Chicago Bridge and Iron Foundation has been made to Marvin D. Pope of Waukesha, Wis. The grant provides a stipend of $750 per semester, full tuition for three semesters' study toward a master of science degree and a research project in an area of interest to the steel plate fabrication industry . . . . . The University of Missouri has received $16,000 from the Missouri State Highway Commission for one-year cooperative research. The College of Engineering will study the economic and structural factors involved in the use of precast concrete units in highway bridges . . . . . A new graduate assistantship of $2,400 in engineering oceanography has been established at Texas A. & M. College by A. H. Glenn & Associates, Houston and New Orleans consultants in meteorology and oceanography. The award will be made in September. Applicants should write to the Head of the Department of Oceanography, A. & M. College of Texas, College Station, Tex. . . . . Twenty-five have re-

(*Continued on page 106*)

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thick copper covering molten welded to steel core

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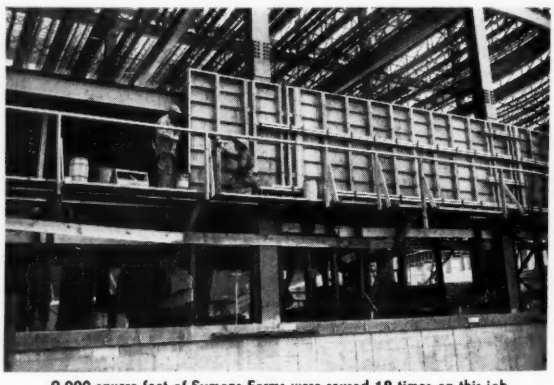

9,000 square feet of Symons Forms were reused 12 times on this job.
William Baumeister Construction Company, St. Paul, general contractor

Spandrel Beam Forming Cost Cut 2/3 with Symons Forms

Because of the efficient combination of Symons forming, shoring and scaffolding methods, the contractor was able to cut his estimated cost by two-thirds on the $2,000,000 home office building of the Minnesota Mutual Life Insurance Company of St. Paul, Minnesota.

In addition to savings in labor cost, considerable time was saved in forming the Spandrel Beams of this 9-story building. The adaptability of Symons Shores with their safe "T" heads speeded the forming and scaffolding work. 2 x 8 Ft. Symons Steel Rib Forms were used to frame 56,000 square feet of Spandrel Beams. Symons Shores were used throughout in beam construction. All foundation walls are 16 feet in height.

Symons Engineering Staff furnished complete form layouts and cost sheets for all the form work. This service was rendered at no charge to the contractor. In addition, Symons fieldmen gave regular on-the-job service.

Symons Forms, Shore and Column Clamps can be rented with purchase option. Paid rentals apply on purchase price. Send in your request for our Catalog F-10 which gives complete information on Symons Forms and Accessories. Symons Clamp & Mfg. Co., 4291 Diversey Avenue, Dept. H-5, Chicago 39, Illinois.

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Asphalt Contractor: ASPHALT INDUSTRIES, INC., Chester, Pa.

Pennsylvania paved this highway with asphalt (penetration) macadam

Where satisfactory stone is available, as in Pennsylvania, Texaco Asphalt Macadam constructed by the penetration method is an ideal answer to the road builder's need for a heavy-duty pavement. In the project illustrated here, Texaco Asphalt Macadam is used to pave a highway link between two of Pennsylvania's principal traffic arteries, U. S. Routes 1 and 13.

In Asphalt Macadam construction, coarse broken stone is laid on the prepared base to the desired thickness, then penetrated by a hot application of Texaco Asphalt Cement. Succeeding applications of smaller stone and asphalt fill the voids in the surface course, forming a waterproof, highly skid-resistant surface. The result is a resilient, rugged pavement, capable of withstanding heavy impact for many years with a low maintenance cost.

Helpful detailed information regarding Texaco Asphalt Macadam is supplied in one of the two free asphalt booklets which can be obtained without obligation by writing our nearest office. These booklets also describe the various other heavy-duty, intermediate and low-cost types of road and street construction obtainable with Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils.

PHOTOGRAPHS

1. Applying hot Texaco Asphalt Cement to compacted layer of coarse broken stone at the rate of 1.75 gallons per square yard.

2. Spreading small stone after application of asphalt to fill voids in layer of coarse aggregate.

3. Using 3-wheel rollers for compaction during construction of Asphalt Macadam pavement.

4. Completed section of heavy-duty, skid-resistant Texaco Asphalt Macadam on this Pennsylvania highway.

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TEXACO ASPHALT

New in Education

(*Continued from page 104*)

ceived fellowships to study at the Yale University Bureau of Highway Traffic this fall. All but one grant are worth $2,000 and cover all the expenses of the one-year course.

Future Engineers. An organization called Junior Engineering Training for Schools (JET) has entered its fifth year of supplying high school students with information about engineering as a study and as a career. Since 1950 the program has spread to include 59 clubs, an active membership of 1,000, and a newsletter, "Jets-O-Gram." The University of Michigan, headquarters for JET, has built up a store of engineering material, lists of books and movies, to encourage interest in this age-group . . . . . The University of Illinois has developed a high school program with a new approach to high school math. The aim is to interest students by appealing to their understanding of the principles and methods of math rather than mechanically memorizing the material. The program grew from a committee formed in 1951 to help schools meet the increasing math requirements of engineering colleges and was adopted two years ago by five schools. Fifteen more schools will adopt the plan this fall.

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Non-ASCE Meetings

American Institute of Electrical Engineers. Pacific General Meeting at the Finlen Hotel, Butte, Mont., August 15–18. Reservations and information from R. J. Labrie, Chairman AIEE Hotel Committee, Montana Power Co., Electric Building, Butte, Mont.

American Public Works Association. Public Works Congress and Equipment Show at the Hotel Schroeder, Milwaukee, Wis., October 2–5.

American Road Builders Association. Third National Conference of County Highway Officials at the Greystone Hotel, Gatlinburg, Tenn., September 12–14. Further details from B. F. Ostergren, American Road Builders' Association, World Center Building, Washington 6, D.C.

American Society of Photogrammetry. Semiannual Convention and Trade Show at the Hotel Statler, Los Angeles, Calif., September 7–10. Further information from American Society of Photogrammetry, Convention Office, 8840 Olympic Boulevard, Beverly Hills, Calif.

Fédération Internationale de la Précontrainte. Second International Congress at Amsterdam, Netherlands, August 29–September 2. Excursions to view prestressed and other construction. Further information from J. A. H. Hartmann, Secretary, Groningsestraat 15, The Hague, Netherlands.

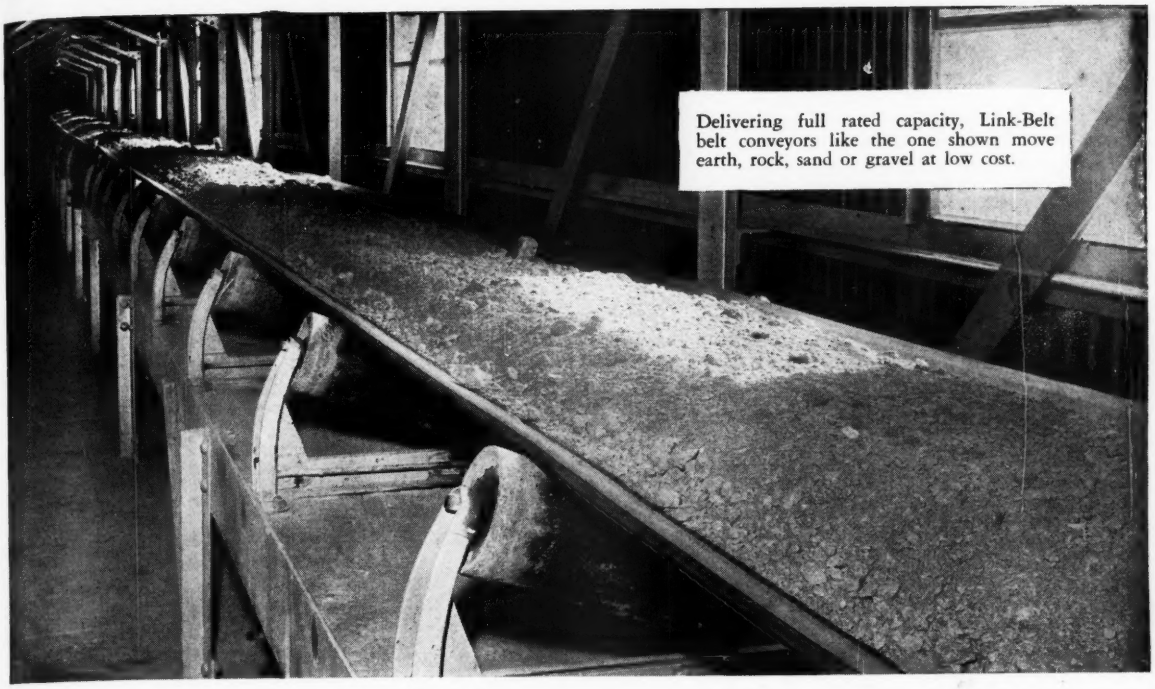
General Motors. General Motors Powerama on South Lake Shore Drive (next to Soldier Field), Chicago, August 31 to September 25. Further information from R. C. Fleming, Director of Public Relations, Allison Division of General Motors Corp., Indianapolis 6, Ind.

Instrument Society of America. Tenth Annual Instrument Conference and Exhibit at the Shrine Exposition Hall and Auditorium, Los Angeles, Calif., September 12–16. Further information from F. J. Tabery, Exhibit Manager, 3443 So. Hill St., Los Angeles 7, Calif.

Society of American Military Engineers. First annual Western Regional Convention at the Olympic Hotel, Seattle, Wash., August 18–20, registration, August 17. Further details from Prof. F. H. Rhodes, Jr., Convention Chairman, University of Washington, Seattle 5, Wash.

Society of Automotive Engineers. Golden Anniversary West Coast Meeting at the Hotel Multnomah, Portland, Ore., August 15–17. Information from SAE, 29 W. 39th St., New York 18, N.Y.

Stanford Research Institute. Symposium on Electronics and Automatic Production at the Sheraton-Palace Hotel, San Francisco, Calif., August 22–23. Second Western Area Development Conference at the Multnomah Hotel, Portland, Ore., September 8 and 9. Co-sponsors are the American Industrial Development Council and the Pacific Northwest Trade Association. Information from Stanford Research Institute, Pacific Northwest Division, Suite 801-2, Equitable Building, Portland, Ore.



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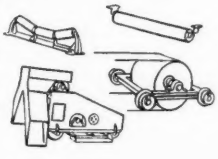

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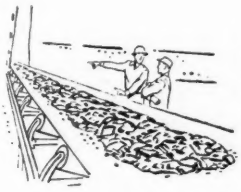

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Music Hall canopy, Houston, Tex. Coliseum, Lloyd & Morgan, Architects; Robert Cummings, Engineer
Fisher Construction Co., Contractors. Photo by Woodallen

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NEW PUBLICATIONS . . .

Land redevelopment. . . American cities are increasingly awakening to the realization that their supply of usable industrial land is lower than it should be from the standpoint of sound economics, according to Technical Bulletin No. 25 just released by the Urban Land Institute. The study suggests exploration of the possibilities of using land cleared for urban redevelopment for industrial and related uses, and blueprints proper methods of approach to the problem. Entitled "Redevelopment for Industry," Bulletin No. 25 may be purchased from the Urban Land Institute, 1737 K St., N.W., Washington 6, D.C. The price is $3 a copy.

Fluid Power. . . The National Fluid Power Association has published two technical reports—"Design, Operation and Maintenance of Hydraulic Equipment for Use with Fire-Resistant Fluids" and "A Glossary of Terms for Fluid Power." Both are available from the association at 1618 Orrington Ave., Evanston, Ill., for 30 and 20 cents respectively (stamps accepted).

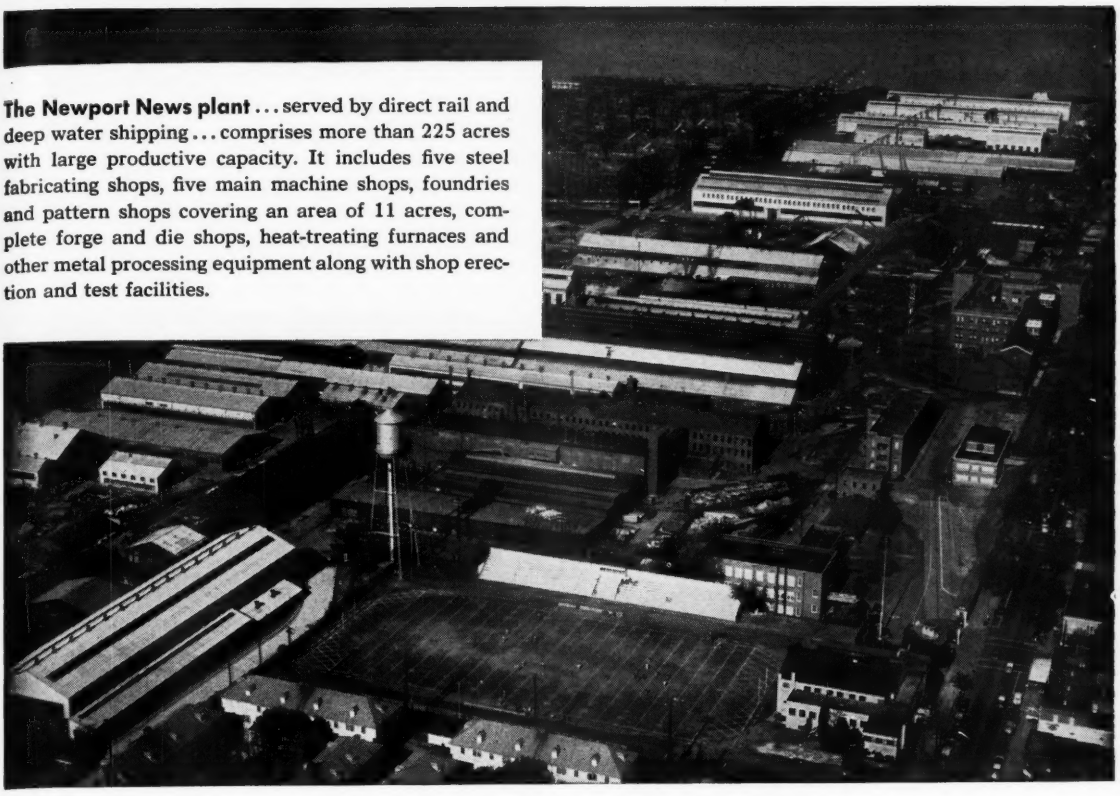
Materials testing. . . Recent technical accomplishments of the American Society for Testing Materials are recorded in the 1954 edition of the ASTM Proceedings. Lead-off article in the 1,400-page volume is a summary of the Proceedings of the 57th annual meeting (held in June 1954) covering 36 sessions. Copies, priced at $12 each, may be purchased from the ASTM, 1916 Race St., Philadelphia 3, Pa.

Highway improvement. . . One of the major problems of highway improvement—the cost and work involved in public utility relocation—is dealt with in a monograph released by the Highway Research Board as Special Report 21. The 200-page publication details an extensive study of the state statutes and constitutional provisions and includes an analysis of more than 250 pertinent judicial decisions in the case. Copies of Special Report 21 are available from the Highway Research Board, 2101 Constitution Ave., Washington, D.C., at $6 each.

Engineering and science as careers . . . Of interest to students, guidance counselors, and engineering and science teachers is the April "Carnegie Technical," the campus technical magazine, which is devoted entirely to problems involved in preparing for careers in engineering and science. A limited number of copies have been reserved for interested persons. Requests should be sent to Daniel Marder, Editor, Carnegie Tech News Service, Carnegie Institute of Technology, Schenley Park, Pittsburgh 13, Pa.

Concrete specifications . . . New ASTM Specifications C332-54T and C331-53T, covering vermiculite concrete aggregate, detail density, insulation value, grading, and other qualities. These specifications, plus C330-53T, replace former ASTM C130-42, written in 1942. Inquiries should be sent to the Vermiculite Institute, 208 South LaSalle St., Chicago 4, Ill.

Highway Financing . . . The facts and expert opinion on federal, state, and local highway problems brought out at the recent two-day National Conference on Highway Financing sponsored by the Chamber of Commerce of the United States are summarized in a new Chamber of Commerce publication entitled *Better Roads for Our Growing Nation.* The booklet also includes 25 pages of up-to-the-minute data on street and highway construction, taxes, motor vehicle totals, highway expenditures and toll roads. Copies are available at $1 each from the Transportation and Communication Department of the Chamber of Commerce, 1615 H Street, N.W., Washington 6, D.C.



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RECENT BOOKS

Basic Engineering Sciences

Problems and Solutions-New York State Professional Engineering Examinations Parts II and III

The first of these booklets for engineers preparing for New York State examinations contains a brief review of fundamentals and answers to 195 questions asked in previous examinations. (Revised edit., 100 pp., $3.00) The second contains 219 problems in economics and practice, hydraulics, machine design, thermodynamics and hygrometry, taken from examinations, 1950–1954. Both books may be ordered from the author, Carlos E. Harrington, 45 Elk Street, Springville, N.Y. (105 pp., $2.25)

The Bomb, Survival and You

The authors—Fred N. Severud, a structural engineer, and Anthony F. Merrill, a journalist with first-hand experience with urban bombings in England—have attempted to bring together all pertinent information in a form that will be of interest to engineers, architects, civil defense workers, and laymen. They discuss characteristic effects of atom bombs; data from Hiroshima and Nagasaki; fire control; shelter construction; protection of machinery; strengthening existing structures; and design of bomb-resistant buildings. The design information included is of a general nature and will be supplemented by a second volume containing mathematical analyses of blast loadings. (Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N.Y., 1954. 264 pp., $5.95.)

Elementary Surveying

The authors, William Horace Rayner and Milton O. Schmidt, professors of civil engineering at the University of Illinois, have aimed at concise and complete coverage of fundamentals, and have given careful consideration throughout to the subjects of errors and checks. In this edition, the chapter on determination of a true meridian has been rewritten, the treatment of coordinates has been revised, and a description of the optical transit is included. (D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y., 3rd ed., 1955. 426 pp. $5.50.)

Engineering Economics and Practice

This is a summary of accepted theory and practice designed as an aid to engineers preparing for professional examinations and as a convenient reference manual for practicing engineers. Topics dealt with include compound interest formulas; depreciation; comparison of alternate proposals; calculating a prospective rate of return; replacements; and costs. Text material is supplemented by questions and solutions to problems taken from Part III of the New York State examinations. Authors are Max J. Steinberg and William Glendinning. (Available from W. Glendinning, 5123 Bell Boulevard, Bayside, N.Y., 4th edit., 1955. 114 pp., $3.00.)

Experimental Mechanics and Properties of Materials

This revision of "Testing of Engineering Materials" (1944) contains twenty laboratory experiments ranging from the stress-strain diagram for mild steel to verification of the moment-area method of determining deflections of beams. Emphasis is on applications of results rather than on details of procedures, with the aim of providing a fundamental understanding of real materials as a prerequisite to good design. Carl W. Muhlenbruch is the author. (D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y., 2nd edit. 1955. 243 pp., $3.00.)

Floods

A comprehensive study by William G. Hoyt and Walter B. Langbein of the causes of floods, their life history, the damage they cause, methods of control, governmental flood-control policy, and river basin projects and plans, both public and private. The volume also includes a history of floods in the United States since 1543, by years and by streams. (Princeton University Press, Princeton, N. J., 1955. 469 pp., $7.50.)

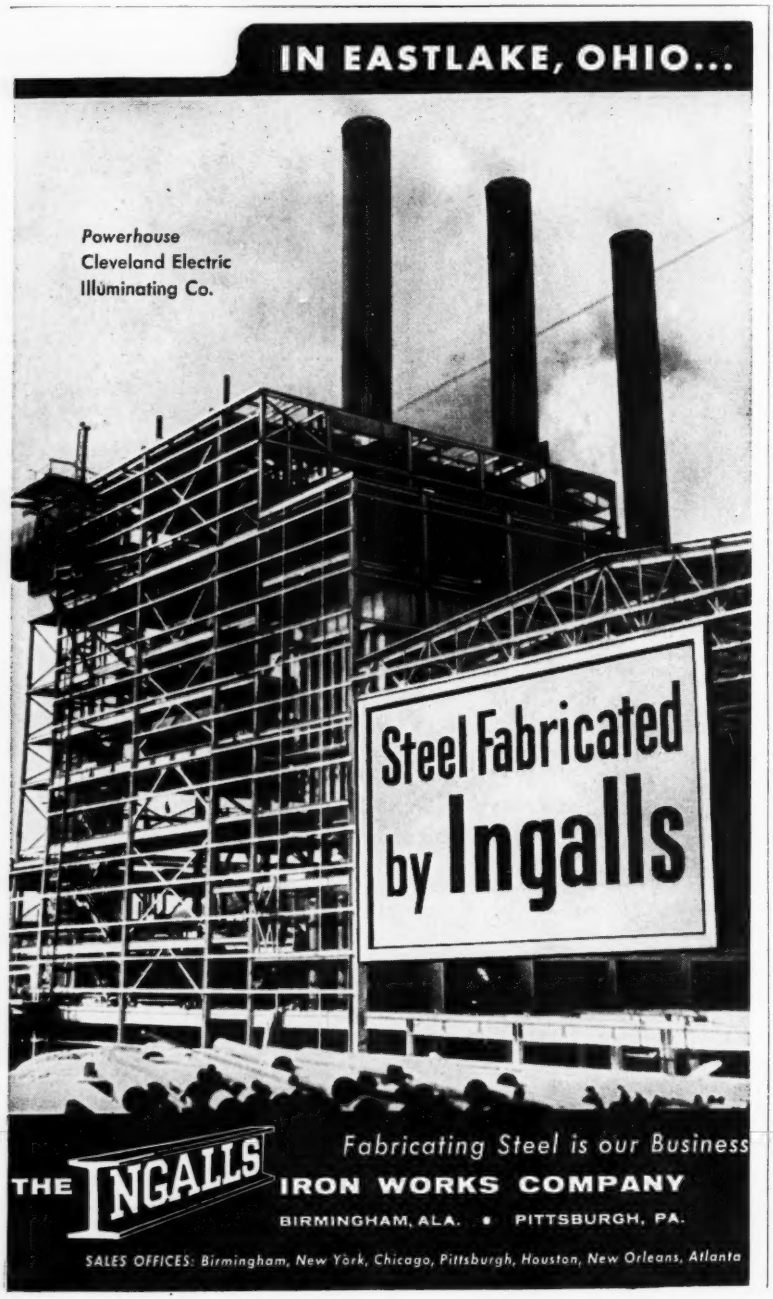
Foundation Engineering

Emphasizing practical problems and their solution, this compact volume by Rolt Hammond deals with foundations for machinery, houses, buildings, bridges, and maritime structures. Throughout the book many examples of actual projects are cited, and a separate chapter is devoted to examples of especially complex operations. Selected aspects of soil mechanics and site engineering are also treated. (Odhams Press Ltd., London, 1955. 192 pp., 21 s.)

L'Instabilité en Mécanique

The three sections of this treatise by Y. Rocard on dynamic instability deal with the following major topics: a general treatment of self-excited oscillations, including application to the problems of a motor vehicle in motion; instability in suspension bridges, with a detailed analysis of the Tacoma bridge case; a practical treatment of airplane wing flutter, longitudinal stability, and

(*Continued on page 112*)



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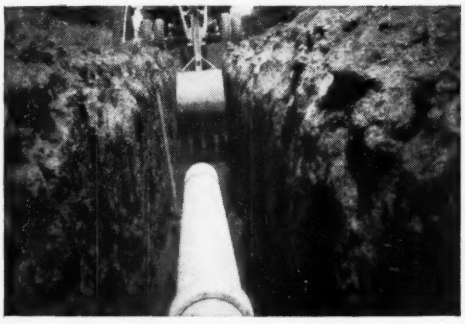

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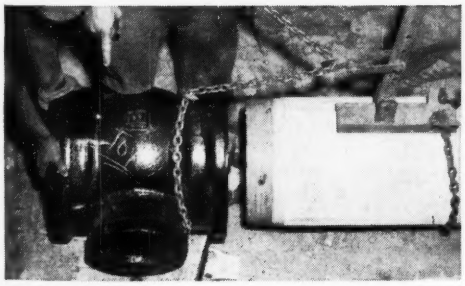

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Recent Books

(*Continued from page 110*)

related matters. The major interest is in the common factors underlying all these conditions. (Masson et Cie, Paris, 1954. 239 pp., F fr. 1200.)

Moving the Earth

This comprehensive, well-illustrated book by Herbert L. Nichols, Jr. is intended mainly for men doing actual earthmoving: small contractors, foremen, and operators, but students, architects and construction superintendents may find it useful. It is divided into two sections, the first discussing the jobs excavation contractors perform—land clearing, problems with different soils, cellars, ditching, roads, tunnels, etc. The second section, being on machines, covers almost every type of excavating, hauling, and grading equipment, giving mechanical descriptions of parts and assemblies, principles of construction, and suggestions on adjustment and maintenance. Also included are a section on construction management and a glossary. (North Castle Books, Greenwich, Conn., 1955. Various paging, $15.00.)

Reinforced Concrete Arch Design

This presentation of a method for calculating the most economical shape and thickness of an arch by C. P. Manning gives values for influence lines for a wide range of arches of different shapes and thicknesses. In general, the slope deflection method is used, but piled abutments and continuous beams are treated by the displacement method, and the flexible arch by an energy method. Examples and figures are based on small and medium span bridges. (Sir Isaac Pitman & Sons, Ltd., London, 2nd edit. 1954. 192 pp., 30s.)

Soil and Water Conservation Engineering

In addition to serving as a text for agricultural engineering students, this book by Richard K. Frevert and others provides considerable basic data for practicing engineers on erosion control, drainage, flood control, irrigation, and land clearing. Fundamentals of hydrology and soil physics are treated, and a chapter is devoted to legal aspects of drainage, erosion control, and irrigation enterprises. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1955. 479 pp., $8.00.)

The Testing and Inspection of Engineering Materials

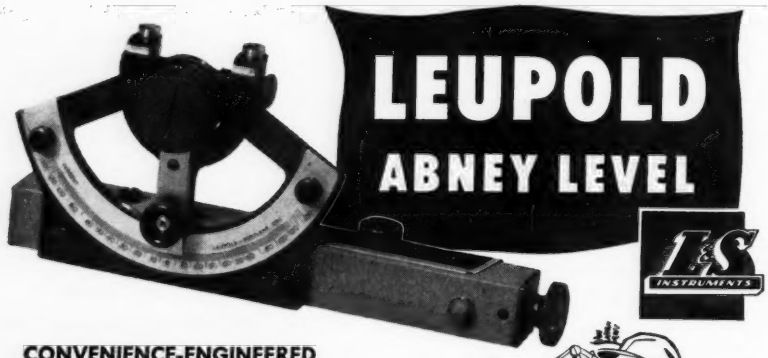
The first section of this book, a general treatment of principles with special reference to mechanical properties of materials, covers measurement of load, length, and deformation, inspection, and the following tests: static tension and compression; shear and bending; hardness and impact; fatigue and creep of metals; and nondestructive testing. The second section describes methods of conducting tests using the most ordinary apparatus. Among the new subjects treated in this edition are ultrasonic testing, low-temperature impact tests, and developments in testing equipment. Harmer E. Davis, George Earl Troxell and Clement T. Wiskocil are the authors. (McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 2nd edit., 1955. 431 pp., $6.50.)

Water Supply Engineering

This standard textbook, by Harold E. Babbitt and James J. Doland, has been revised to include information on the latest accepted practices, and has been broadened in scope by the inclusion of material on industrial water supplies. Emphasizing design throughout, the coverage includes estimation of water usage; determination of water availability; fundamentals of hydraulics; materials of construction; design and maintenance of pumping stations and distribution systems; and methods of water purification. Numerous references to source material are given in order to make the book useful to practicing engineers and advanced students. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 5th edit., 1955. 608 pp., $8.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.



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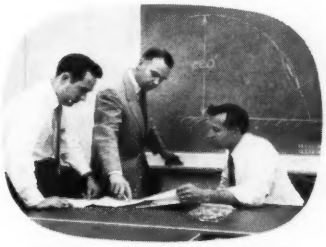
A report on "High Heat Treat Steel" taken from one of Lockheed's monthly engineering and manufacturing forums is available to interested engineers. Address requests to the forum chairman, E. H. Spaulding.

Engineers interested in Lockheed's expanding development and production program are invited to write to E. W. Des Lauriers, Dept. MP-1-8.

Below: Lockheed engineers at work on various projects

Operations Research study on overseas transport routes



Aerodynamic meeting on high-speed fighter

Fatigue test on Super Constellation skin

Antenna pattern study on radar search plane

Design study on hydraulic requirements of new transport

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CONSTRUCTION ENGINEER; J.M. ASCE; Engineer-in-Training; B.S.C.E., 1951; 28; married. Desires position in construction or with engineering firm. Two years' experience as construction supervisor on airbase projects, and last two years as field engineer on hydroelectric project consisting of preliminary damsite investigations, field design. Location preferred, western U. S. C-63-623-San Francisco.

CIVIL ENGINEER; J.M. ASCE; B.S.C.E., 1951; 26; married; 1 years experience in aircraft stress analysis, three years' commissioned service in U. S. Navy performing explosive demolition. Desires engineering position in consulting or construction field. Location preferred, West or Midwest, will accept Foreign. C-64-622-San Francisco.

SANITARY ENGINEER; J.M. ASCE; M.S.E.; P.E. Connecticut; age 30; five years' water supply, sewage treatment experience with State Health Department, and two years' supervisory experience water supply, treatment, pumping, personnel with large municipality. Desires responsible sanitary engineering position preferably in management and operation. C-65.

ESTIMATOR; J.M. ASCE; MIT graduate; five years' varied field experience as field superintendent and engineer for general contractor. Desires responsible position with good advancement possibilities in office of general contractor as estimator, expeditor, general office engineer or similar capacity. C-66.

STRUCTURAL ENGINEER; A.M. ASCE; B.S.-C.E., 1941; Registered La., Fla., Ill.; 14 years' structural, sanitary, construction experience in design and contract administration, field and office. Desires responsible position with engineering or industrial firm in South offering opportunity for professional advancement. C-67.

CIVIL AND AGRICULTURAL ENGINEER; M. ASCE; B.S. in Agricultural Engineering, post graduate study in mechanical, civil and structural engineering; P.E.; 45; married; 22 years' experience in land and water management and hydrology, 15 as project supervisor. Available for management, consulting or research, land and water resources, agricultural equipment, structures, production. Location preferred, California coastal area. C-68-725-San Francisco.

CIVIL ENGINEER; J.M. ASCE; Engineer-in-Training, Wisconsin; B.S.C.E. Marquette University, 1953; 24; married; on active duty with USMC; available October 1955. Midwest location in structural engineering field preferred. C-69.

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ASSISTANT PROFESSOR; preferably with M.S. degree, to teach any branch of civil engineering. Salary open. Location, East. W-1651.

WATER RESOURCES COORDINATOR; minimum of five years' experience in water works operation and management. Salary, $8,000 a year. Location, Westchester County, New York. W-1672.

SOILS ENGINEER; for soils inspection, analysis of geological reports, and field surveys on highways, bridges, airfields. Some traveling. Salary, $6,000 a year. Location, New Jersey. W-1676.

CHIEF ESTIMATOR; at least ten years' supervisory estimating experience covering complete take offs, pricing, handling sub-contractors and negotiating with clients. Works involves office buildings, institutional and general building construction. Salary, $12,000 a year plus bonus. Location, Pennsylvania. W-1677.

ENGINEERS; (*a*) Civil Engineer; graduate; with about three years' varied experience in municipal work, particularly on streets and sewers, to make surveys, design plans, estimates and supervise construction. (*b*) Junior Civil Engineer; graduate; with one year's experience in civil engineering; some knowledge of streets and sewers. Will assist the civil engineer. Recent graduate will be considered. (*c*) Supervisor of sidewalks; civil graduate; with one year's experience in civil engineering; some knowledge of curbs, sidewalks, concrete construction and line and grade work. Will inspect the condition of sidewalks and curbs. (*d*) Assistant Building Inspector on construction of buildings and structures. Will assist the building inspector in examining plans and applications for new buildings. Residents of New Jersey preferred. Location, northern New Jersey. W-1688.

SALES ENGINEER; 26–32; with engineering training and construction experience to sell asphalt products and accessories. Salary, $4,800 a year, plus expenses. Location, New York Metropolitan Area. W-1689.

ARCHITECTS; (*a*) Architectural Engineer; two to three years' general architectural experience. Will develop basic information necessary for the preparation of layouts, plans and specifications for sanitary sewage and industrial waste disposal systems, and other projects. (*b*) Architectural Draftsman; three to four years' experience; recent graduates considered. Will detail drawings of industrial buildings and warehouses; must be able to render and draw perspectives. Location, western Pennsylvania. W-1695.

SALES ENGINEER; 25–35; to contact owner, architects, general contractors and sell concrete hardeners, water proofings, abrasives, etc. Salary, $5,200 a year plus commission. Must be New Jersey resident. Territory, northern New Jersey. W-1698.

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STRUCTURAL DESIGNERS; steel and concrete experience and a minimum of five years' experience in power plant and steel mill. Salary, $6,700 a year. Location, Philadelphia, Penna. W-1726.

INSTRUCTOR OR ASSISTANT PROFESSOR; three to six years out of college. Will teach in the field of structural design and materials testing, with a possible alternate in hydraulics. Salary, $4,500–$6,000 a year. Location, Midwest. W-1733.

SENIOR HYDRAULIC ENGINEER; civil graduate; three years' experience in hydraulic engineering including problems in hydraulics and design of hydraulic structures, experience in hydraulic laboratory testing of models desirable. Will write technical reports on related works. Salary, $4,980–$6,180 a year. Location, New Jersey. W-1738.

TEACHING PERSONNEL; Department of Civil Engineering and Mechanics; 22–32. (*a*) Hydraulics (*b*) Structures with general civil engineering subjects (*c*) Mechanical and Experimental Stress Analysis. Positions available fall 1955. Salary dependent upon education and experience. Location, Pennsylvania. W-1757.

ENGINEERS; (*a*) Field Engineer; 35–55; preferably with engineering degree and at least ten years' heavy industrial construction experience. Will supervise field engineering, scheduling, costs, plan changes and safety. (*b*) Junior Engineer; graduate; will assist in field engineering, planning, scheduling, etc. Salary open. Location, East. W-1767.

SANITARY ENGINEER; for sales division; graduate civil; with practical experience in sewage, water or trade waste treatment. Salary open. Location, Connecticut. W-1774.

ENGINEERS; (*a*) Plant Engineer; 25–35; B.S.C.E. or mining; with experience in connection with quarrying mining or processing rock products. (*b*) Assistant Engineer for engineering department; 25–35; B.S.C.E.; experience in steel and concrete structural design for office and field work. Salaries open. Location, South. W-1775.

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INSTRUCTOR OR ASSISTANT PROFESSOR; in civil engineering, to teach mechanics, mechanics of materials, soil mechanics and surveying. Salary open. Location, New England. W-1823.

SALES ENGINEER; civil graduate; with sales and field engineering experience in sanitary engineering field. Will call on municipalities, industries and engineering firms covering sewage and industrial waste disposal plants. Salary, $6,000–$8,000 a year. Location, Midwest. W-1831.

FIELD ENGINEERS; civil graduate; young; with two to three years' experience for work on highways and structures. Salary open. Location, Westchester County, New York. W-1844.

ENGINEERS; (*a*) Construction Manager; 45–50; with experience in construction of petroleum and/or chemical plants, consisting of considerable process equipment; general building construction

(*Continued on page 116*)

AIRCRAFT ENGINEERS
With Experience
WANTED AT
GRUMMAN

LAYOUT DESIGNERS
Airframe Structures

FLIGHT TESTING
Planners
Analysts

HYDRAULICS
Systems Design
Testing

STRUCTURES
Stress Analysis

RESEARCH
Computer Engrs. Digital or Analog
Vibration & Flutter Engrs.
Dynamic Analysis—Systems Engineers

ARMAMENT INSTALLATION
AERODYNAMICS
INSTRUMENTATION
TOOL DESIGNERS

Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

Proof of U. S. Citizenship Required
APPLY IN PERSON
OR SEND RESUME TO:
Engineering Personnel Dept.
INTERVIEWS AT
Employment Office
South Oyster Bay Road
North of Railroad
Monday thru Friday
8:30–11:30 AM; 1:30–3:30 PM

GRUMMAN AIRCRAFT
Engineering Corp.
Bethpage, N. Y.

Men and Jobs Available

(*Continued from page 115*)

experience will not suffice. Salary, $10,000 a year plus bonus. Location, Delaware. (*b*) Chief Estimator for national construction company dealing with the construction of petroleum and chemical plants. Salary, $12,000 a year plus bonus. Location, probably Midwest. W-1845.

JUNIOR OR SENIOR DESIGNER; Structural; 30–45; with two to ten years' experience in design and evaluation, stress analysis of structures, trusses, etc. Will make stress analysis, design trusses and cranelike structures, determine hoists and travel power requirements, evaluate performance and specify or recommend fabrication methods. Salary, $4,800–$8,400 a year. Employer will pay fee. Minimum traveling. Location, Wisconsin. C-3261.

PROJECT ENGINEER; 25–45; with at least two years' experience in designing concrete structures or mechanical structures, or similar lines. Knowledge of applied mechanics helpful. Will do drafting and design of product, machinery, concrete or structural work or other assignments as they come up. For manufacturer of machinery and concrete. Salary, to $7,200 a year. Employer will negotiate fee. Location, California. C-3321.

BUILDING INSPECTOR; civil engineer; for building inspection, coordination of department, community planning. Eventually will be worked into position of Village Engineer. Salary, $4,800–$6,000 a year. Employer will pay fee. Location, southwest Chicago suburb. C-3325.

SALES ENGINEER; 27–35; with at least two years in construction work, preferably building materials. Will contact architects, chemical engineers, engineers and contractors selling line of soapstone for laboratory purposes and marble for architectural purposes. Salary, $4,800–$6,000 a year. 25% travel; car required. Employer will negotiate fee. Headquarters, Chicago, Ill. C-3370.

Applications for Admission to ASCE, June 18, 1955–July 9, 1955

Applying for Member

MARTIN TRESTER DYKE, Chicago, Ill.
JAMES LAFFETER GREEN, Washington, D.C.
GEORGE BROWN GUDGELL, III, Salt Lake City, Utah
TYLER MCWHORTER HARR, Honolulu, T.H.
KONSTANTIN KETCHEK, Rochester, N.Y.
WILLIAM GALLUCHAT KIRKLAND, New York, N.Y.
ERNEST BAINBRIDGE LIPSCOMB, Vicksburg, Miss.
WILLIAM MORRIS LITTLEFIELD, Los Angeles, Calif
WALTER ELMORE MCKIBBEN, Olympia, Wash.
GEORGE GUINAN MOONEY, Miami, Fla.
DONALD DAVID MORGAN, Lodi, Calif.
STANLEY JULIUS ORLOWSKY, New York, N.Y.
THOMAS HUGH PETERSON, Oakland, Calif.
GEORGE PARKER PRICHETT, Des Moines, Iowa
MYRON SHERMAN RAUDEBAUGH, SR., Canton, Ohio
EDWARD JOSEPH RICER, New York, N.Y.
DOUGLAS CHARLES SEELEY, Washington, D.C.
GORDON LANE SHANKS, Los Angeles, Calif.
RUPERT BROADHURST SPEARMAN, Boulder City, Nev.
KENNETH JULIAN STEDELIN, Little Rock, Ark.
PAUL SOUTHWORTH SYMONDS, Providence, R.I.
KENNETH GEORGE WILKES, Los Angeles, Calif.

Applying for Associate Member

LAWRENCE GIDNEY AMUNDSEN, Sacramento, Calif.
FRANCIS CHARLES BAYLIS, Martinsburg, W.Va.
DOROTHY JEWETT BRIGHT, Bishop, Calif.
DOUGLAS STRAUGHN BRINKLEY, Washington, D.C.
CHARLES CALVIN CROSS, San Antonio, Tex.
MAHMOUD RIFAT HALLAB, Minneapolis, Minn.
HAROLD HEINBUCH, Canton, Ohio
CHARLES FREDERICK HOFMANN, Lima, Ohio
LAWRENCE HUFTY, JR., Washington, D.C.
RALPH RICHARD IKELS, San Antonio, Tex.
RICHARD KIMELMAN, Massena, N.Y.
OHN KYINE, Rangoon, Burma
NICHOLAS MAVRONAS, Athens, Greece
PANAGIOTIS MITROPOULOS, Athens, Greece
WILLIAM JIT THYE NG, Urbana, Ill.
PHILLIP VIRGIL RUSSELL, Porterville, Calif.
VICTOR BROWN UEHLING, Boulder City, Nev.
JOHN JOSEPH WEIDER, Hazel Crest, Ill.
CHARLES FILLMORE WELLS, JR., Atlanta, Ga.
NOEL WOODWARD WILLIS, Philadelphia, Pa.

Applying for Junior Member

PAUL HAROLD BERRY, Syracuse, N.Y.
WALTER ALDEN BUNDY, Ithaca, N.Y.
VINCENT MAURO CANGIANO, Providence, R.I.
RAYMOND JOHN CERIANI, Boston, Mass.
URI EIDELSON, Tel-Aviv, Israel
DON WALKER HANDLEY, San Francisco, Calif.
ARTHUR VINCENT HOGAN, JR., Valley Stream, N.Y.
NACHMAN IZBICKI, Tel-Aviv, Israel
EDWIN LEE, San Francisco, Calif.
YU-TEK LI, Ithaca, N.Y.
LINO JOSEPH MARSON, Ottawa, Ont., Canada
BILLY MACK RADER, Kansas City, Mo.
ALLAN LOUIS RAE, Lincoln, Nebr.
HARRY GILSON SCURLOCK, El Paso, Tex.
WALTER LEE SPANNAUS, Duluth, Minn.
ROBERT STERLING TURNER, Pullman, Wash.

[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

HIGHWAY ENGINEERS

A rapidly expanding organization devoted exclusively to highway engineering has openings at all levels for men experienced in the design of highways, freeways, expressways and associated work.

Work is in air-conditioned St. Louis office on long-term projects, with ample opportunity for professional development and advancement.

Assistance with moving expenses, excellent employee benefit and retirement plan, Blue Cross, paid vacations and holidays and sick leave.

Please send complete experience record, references, date available and salary desired in first letter.

SVERDRUP & PARCEL ENGINEERING CO.

1134 Locust Street St. Louis 1, Mo.

Design Engineers

Graduate Civil Engineers for design of oil refinery plant facilities. Prefer men having professional engineer's license. Applicants must have a minimum of 4 years' experience in design plus familiarity with drafting room procedures. These are career positions. Salaries commensurate with ability and experience. Liberal employee benefits. Plant located in Baltimore, Maryland.

Write giving resumé of experience and education to:

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STANDARD OIL COMPANY
Box 5197, Highlandtown Sta.
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To Order

"Billings and Water Power in Brazil"

Fill in this order blank and mail to:

American Society of Civil Engineers
33 West 39th Street
New York 18, N. Y.

Enclosed find check (or money order) for $_____ ($7.00 per copy,* prepaid for shipment in United States)

Please send "Billings and water Power in Brazil" to the following address:

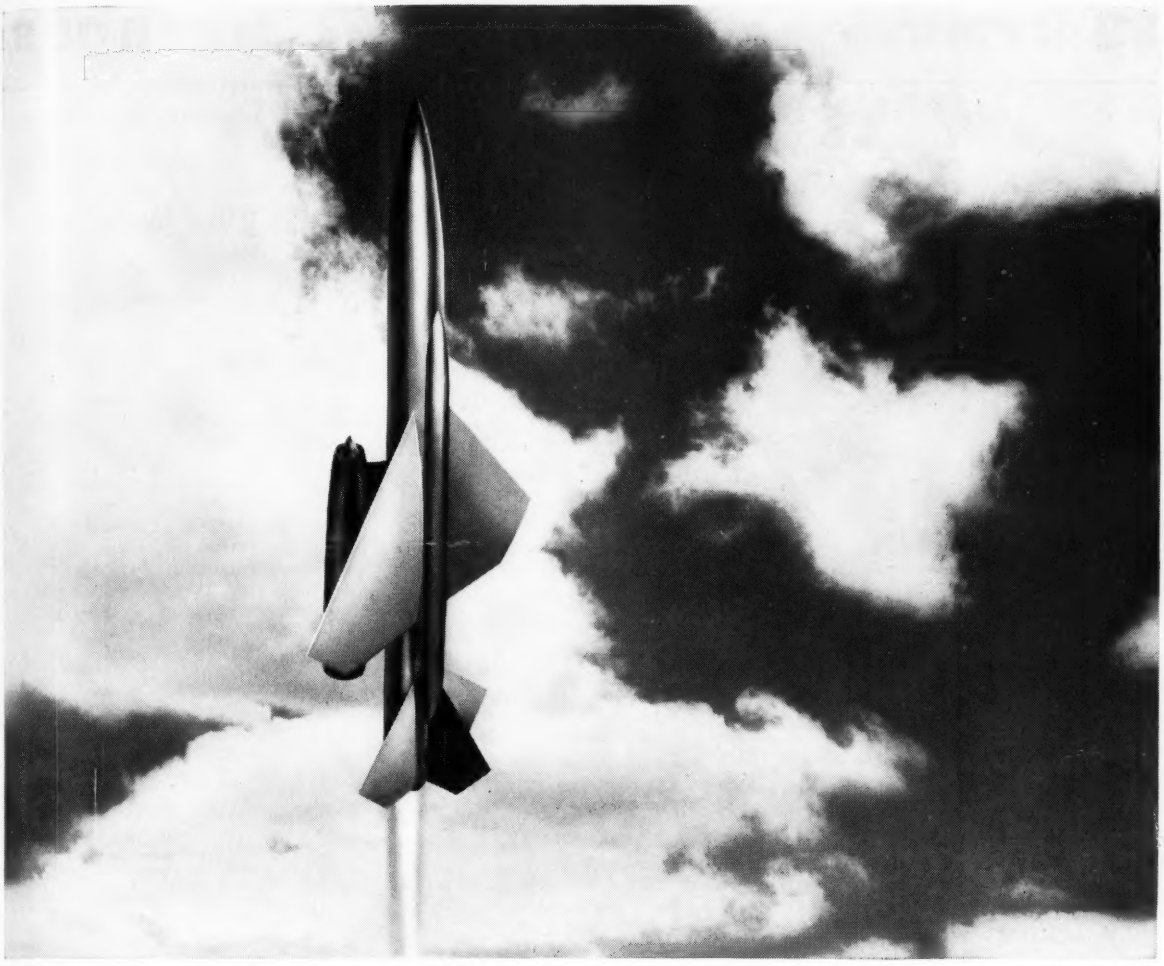
Name .....

Address .....

City .....

State .....

*10 percent discount in lots of 10 or more



Boeing "C.E.'s" have a date with the future

Guided missiles like this Boeing Bomarc IM-99 are increasingly important in America's defense planning. Boeing civil engineers play vital roles in developing the Bomarc, and the hypersonic vehicles and guided missiles of the future. These men explore the frontiers of engineering knowledge in designing structures and components to "weigh nothing and take no space," and in conducting structural tests, analysis and development.

Boeing civil engineers are members of aviation's top creative team. They are now working on projects involving new materials like titanium and magnesium alloys, new non-metallics used in extremes of altitude, vibration and temperature. The resulting aircraft will maintain the prestige of the Boeing B-47 . . . the B-52 . . . the Bomarc IM-99 . . . and, most recently, the KC-135, America's first all-jet tanker-transport.

At Boeing, engineers' professional achievements are recognized by regular merit reviews and in other ways. The Boeing policy is to promote from within the organization. And Boeing is known as an "engineers' company." One out of every seven employees is an engineer! Among top management, the proportion is even higher.

Equipment at Boeing is superb: the latest electronic computers, a chamber that simulates altitudes up to 100,000 feet, splendidly equipped laboratories, and the new multi-million-dollar Flight Test Center. The world's most versatile privately owned wind tunnel, at Boeing, is soon to be supplemented by a new tunnel capable of velocities up to Mach 4.

Do you want a career with one of America's most solidly growing companies? Do you want a chance to grow, and to share in the challenging future of flight? Then there's a place for *you* on one of Boeing's engineering teams in design, research or production.

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Co., Dept. D-42, Seattle 14, Wash.

Please send further information for my analysis. I am interested in the advantages of a career with Boeing.

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

120,000 Lb. Giant Tree Crusher

A GIANT JUNGLE DESTROYER, TRAVELING ON THE LARGEST RUBBER TIRES IN THE WORLD, is now doing a major land-clearing job in the Florida-Georgia coastal area. Designed to uproot heavy trees and underbrush with push-button ease, this six-wheeled Tree Crasher has three times the power of an M-24 tank, yet it is so light that it can roll over a pocket watch without damaging it. The power lies in the wheels of the machine, each of which measure 4 ft wide and 10 ft tall Instead of receiving power from one central drive, each of the wheels has within its rim an individual electric motor and gear reduction. These motors are driven by generators which, in turn, are driven by two huge diesel engines near the center of the unit. The secret of the light weight of the 120,000-pound vehicle again lies in its tires. Because of their size and ability to operate with low air pressures, the actual per-sq-in. weight of the machine upon the ground is about the same as that of a walking man. All of this makes the unit well-suited for work in swampy or sandy areas. **R. G. LeTourneau, Inc., CE 8-118, 2399 South MacArthur, Longview, Texas.**

Relief Maps

YOU GET A FRESH VIEW OF THE WORLD with a new series of relief maps. Printed in bright colors on heavy Vinylite, the maps are molded to show all land forms clearly. The maps' naturalistic colors depict different types of land uses. Plastic coating protects their surfaces, so they can be marked with china marking pencil. They clean easily, and weigh about two pounds, compared with 200 pounds for plastic relief models of the same size.

The present series includes the United States, New Jersey, Venezuela, and California. Maps of Canada and Wisconsin will be available shortly; ones of Europe and the World are scheduled for September and January, respectively.

As illustrated, the map of California shows all the state's mountains, valleys, and drainage patterns in third dimension. Mt. Whitney stands up three-fourths of an inch from the lowest point on the map, Death Valley. Over 3,000 geographic names are shown—2,000 cities and towns, plus parks, rivers, lakes, dams, aqueducts, State and U. S. Highways, airports, and Army, Navy, and Air Force bases.

Vinylite Maps

Land use throughout the Golden state is depicted—croplands, commercial timber, semi-arid lands, and seven other land uses. Part of Nevada is shown, including the Reno-Lake Tahoe and Las Vegas-Lake Mead areas. Tia Juana and Agua Caliente are also shown.

The maps cost between $37.50 and $45. each. If more information is desired, please write or phone **E. E. Dando, Aero Service Corp., CE-8-118, 68 Post Street, Room 420, San Francisco 4, California.**

Tractor-Scrapers

SCRAPERS WITH CAPACITIES UP TO 41 CU. YDS, said to be the largest standard models ever available, are offering wide base tires for greater flotation and carrying capacity. Of open bowl, cable operated type, Scraper Model OS-300 has capacities of 41.0 cu. yds heaped and 34.0 cu. yds struck. The OS-260 is rated at 35.0 cu. yds heaped, 30.0 struck, with side extension, or 32.5 heaped and 26.0 struck without extensions. Model OS-200 with side extensions carries 28.0 cu. yds heaped and 24.0 struck, or 26.0 heaped and 20.0 struck without extensions. This completes a line of six basic models covering a range from 10.5 to 41.0 yard capacities. **Wooldridge Manufacturing Division of CCS, CE 8-118, Bulletin No. OS-251, Sunnyvale, Calif.**

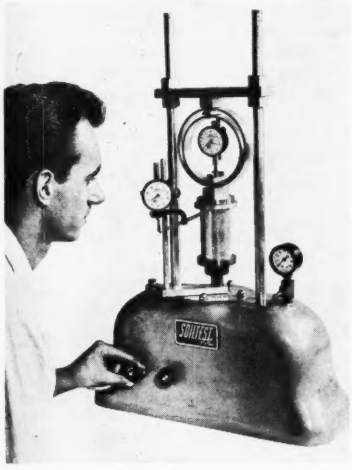
Model OS-300

Aerofloc Reagents

A NEW GROUP OF SYNTHETIC POLYMERS HAVE THE ABILITY TO AGGLOMERATE FINELY-DIVIDED SOLIDS in suspensions so that settling and filtration are accelerated. Developed originally for the mining industry, Aerofloc Reagents also should have application in water, sewage and industrial wastes treatment. In water treatment, Aerofloc Reagents agglomerate colloidal material and organic slimes, thereby increasing the effective capacity of presently installed filters. According to the company, the addition of small quantities of Aerofloc Reagent will accelerate the settling of raw sewage. Addition of small quantities at the digestion stage will speed up the settling of colloidal suspensions from the settled sewage, thereby producing a clearer supernatant overflow. Aerofloc Reagents are large, complex molecules which, when added to aqueous suspensions, bond together the individual fine solid particles into flocs. These flocs settle more rapidly than the unconsolidated particles, leaving a clarified supernatant suitable for re-use or for discarding without creating a pollution problem. **Mineral Dressing Dept., American Cyanamid Company, CE 8-118, 30 Rockefeller Plaza, New York 20, N. Y.**

Soil Compression Tester

A PORTABLE UNCONFINED COMPRESSION TESTING MACHINE FOR SOILS makes possible rapid job site or laboratory testing to determine stress and strain relationships of soils for foundation design and construction control. The hydrauli-



Portable Tester

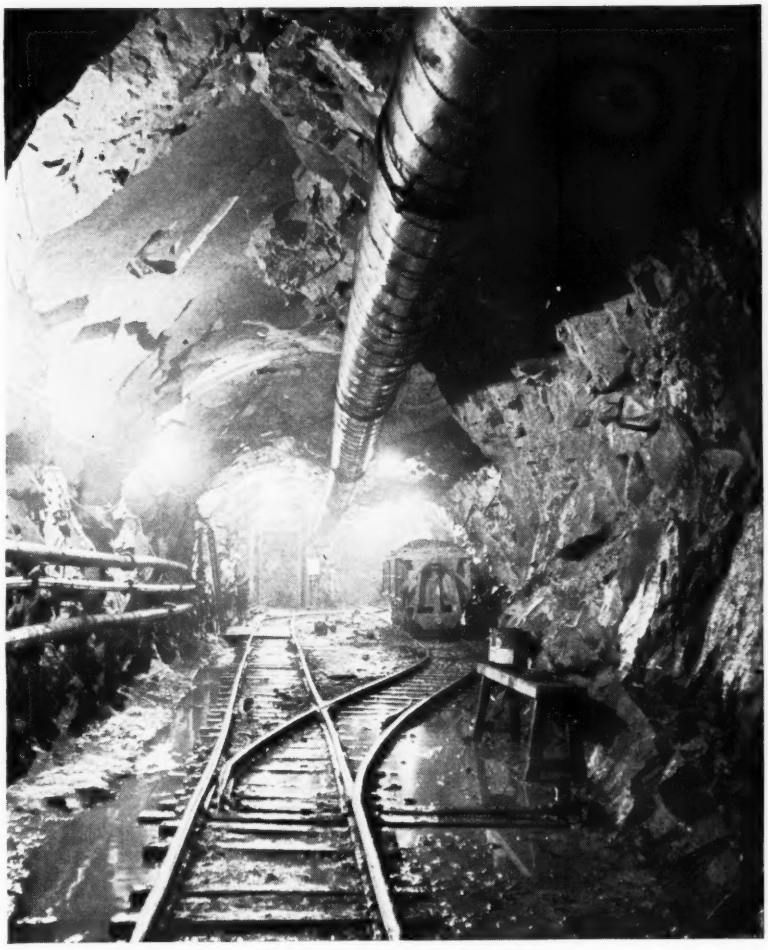
cally operated tester has a total load capacity of 500 pounds. Loads are measured on a sensitive double proving ring assembly. Specimens up to $2^1/_2$ in. in diameter can be tested. The portable testing machine has a one piece aluminum base with integral air and fluid reservoirs. Total weight is only 35 pounds. **Soiltest Inc., CE 8-119, 4711 W. North Ave., Chicago 39, Ill.**

Vertical Sand Drains

THE VERTICAL SAND DRAIN PRINCIPLE, INTRODUCED IN 1934, now ranks among the leading methods for stabilizing soft marshy ground. One of the most important of its applications is in the consolidation of foundations for highway construction. The Garden State Parkway, recently completed, is one of a growing number of projects in which vertical sand drains have been extensively employed. But the method is by no means limited to highway construction. Hundreds of sand drains, ranging from 15 to 90 ft, were driven on the extension of the Lincoln Tunnel approach and over 3,000,000 lineal ft of sand drains were employed in the building of the New Jersey Turnpike. A sand drain system consists of a series of sand columns driven through a blanket of sand into an unstable

(*Continued on page 120*)

DEEP BREATHING



You can't dig a tunnel without adequate air supply and there's no better vehicle for push-pull ventilation than lightweight Naylor Spiralweld pipe. That's why you see so much of this distinctive pipe in underground construction. It's easy to handle, install and extend as work progresses, particularly when you use the one-piece Naylor Wedge-Lock coupling to speed connections. The exclusive lockseam spiralweld structure adds collapse strength, permitting the use of lighter gauge material for economy.

For your "deep breathing" jobs, it will pay you to check these Naylor advantages. Write for Bulletin No. 507.

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Eastern U. S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

200,000 LB. CAPACITY

concrete tester...

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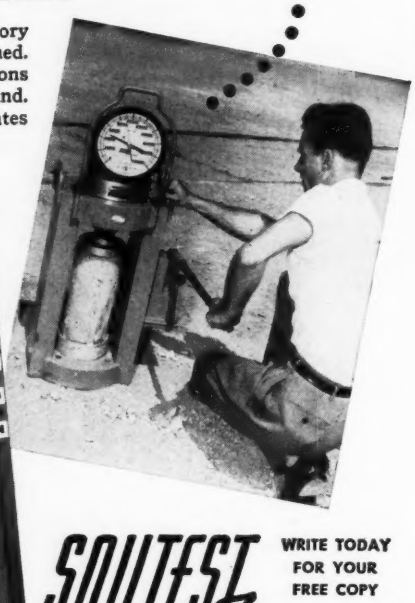
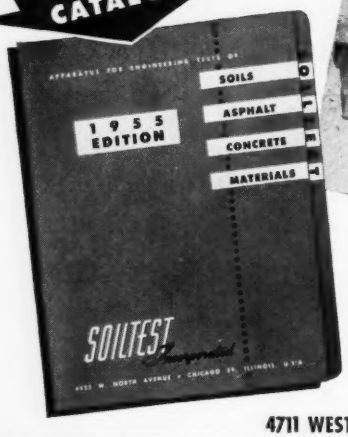
Compact and portable for laboratory and field use. Entirely self contained. No electrical or pressure connections required. Simply operated by hand. Large, direct reading dial indicates result of test.



NEW 1955 CATALOG



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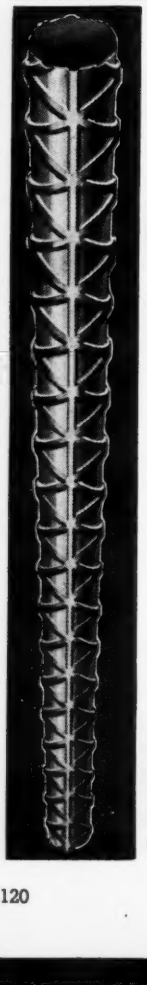

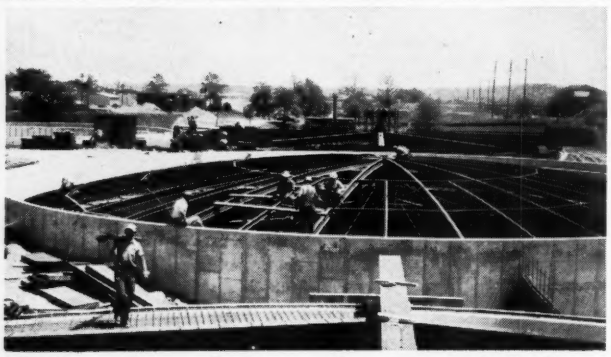

"The Steel Service Couldn't Have Been Better"*

*So reports Sullivan, Long & Hagerty, General Contractors, about Connors' service in supplying the concrete reinforcing steel for Jefferson County's mammoth, $4,000,000-plus Sewage Treatment Project.

All Connors' customers get the same superior service on their steel orders . . .

CONNORS PRODUCTS

- *Reinforcing Bars*
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CONNORS STEEL DIVISION
H. K. PORTER COMPANY, INC.
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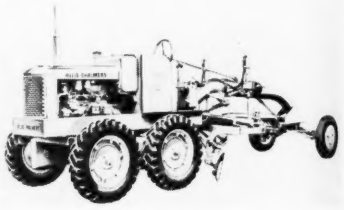
EQUIPMENT MATERIALS and METHODS

(continued)

soil body. Water from the soil rises up the columns of sand to the sand blanket, from which it drains horizontally. The construction of a sand drain system begins with a determination of the depth of the unstable soil. A blanket of sand is spread on the surface to support equipment and to drain away water rising from below. A mandrel is driven through the sand blanket and into the muck. Compressed air is forced into the mandrel, and the sand column is thus held in place while the mandrel is withdrawn by the crane. Either single-acting or double-acting pile hammers may be used in the construction of sand drains. **McKiernan-Terry Corp., CE 8-119-20, Dover, N. J.**

Diesel Motor Grader

THE MODEL D DIESEL MOTOR GRADER HAS A SIX CYLINDER, VALVE-IN-HEAD DIESEL ENGINE rated at 50 brake maximum h.p. at 1625 rpm. The Diesel engine has a $3^{7}/_{16}$ in. bore and $4^{1}/_{8}$ in stroke, and 230 cu. in. piston displacement. Direct electric starting on Diesel fuel is provided by a 12-volt starting



Model D

system. Incorporated in this engine are features such as replaceable wet-type cylinder liners; by-pass cooling system with high capacity water pump; pressure lubrication; aluminum alloy pistons; simple, easily serviced duel injection system; and four filters to assure clean fuel. Weight of the Model D Diesel is 9,350 lbs. Blade pressure is 4,900 lbs. Speeds with 7.50 × 20 tires range from 2.6 mph in first gear to 25.2 mph in fourth gear. **Allis-Chalmers Manufacturing Company, CE 8-120, Tractor Division, Milwaukee 1, Wisconsin.**

Transparent Film

FIVE YEARS OF EXPERIMENTING HAS PRODUCED STABILENE FILM, A REPRODUCTION MATERIAL, popular in government map making because of its high transparency and dimensional stability, and

EQUIPMENT MATERIALS and METHODS

(continued)

now available to engineers and draftsmen in private industry. Features such as its fibre-free drawing surface, flexibility and initial tear strength also make it an ideal product for many other uses, like making patterns or templates on work surfaces or for optical comparator work, or in printed circuits and wiring design. Has exceedingly high tensile strength, good impact resistance and a longer flex life. Stabilene film is made with several types of surface coatings which are translucent and will accept pen and ink drawings, a scribe coat for scribing and a variety of light sensitive solutions, including blueprint, brownprint, dry diazo (Helios), and moist diazo (Onyx). **Keuffel & Esser Co., CE 8-120-21, 300 Adams St., Hoboken, N. J.**

Photocopier

THE CORMAC BOOK-PRINTER IS THE FIRST AUTOMATIC PHOTOCOPY MACHINE TO COPY DIRECTLY FROM THE PAGES OF BOUND BOOKS. It makes exact copies margin-to-margin and clear to the binding. In

Automatic Book-Printer

20 seconds it produces dry copies on any weight paper, on one or both sides, in black-and-white or with colored background. The unit will copy anything written, printed, typed, drawn, stamped or photographed. It is designed for use with regular processing units. In the operation, the exposed negative sheet is placed against a positive sheet and both are fed into the processing unit. Cost of the Book Printer is $139.00. **Cormac Industries, CE 8-121, 80 Fifth Ave., New York City.**

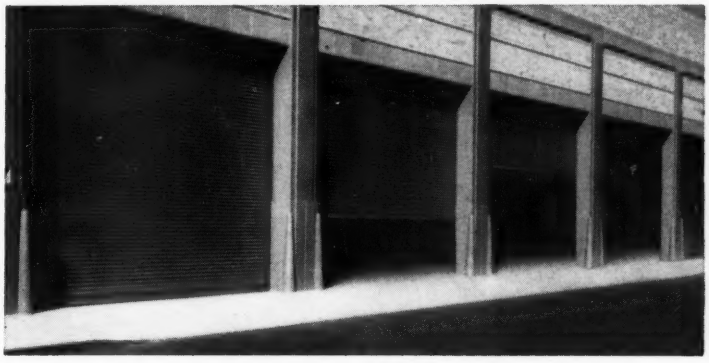
Diesel Crawler Tractor

THE TD-18A, CRAWLER TRACTOR, INCORPORATES PRECISION MANUFACTURING IN TRACK FRAME ASSEMBLIES, claims the manufacturer. Power in this machine has been increased to 103 drawbar h.p., a

(*Continued on page 122*)

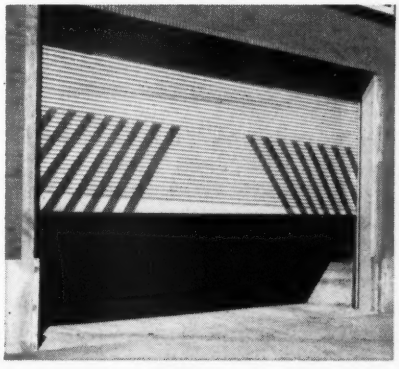
Kinnear Steel Rolling Doors

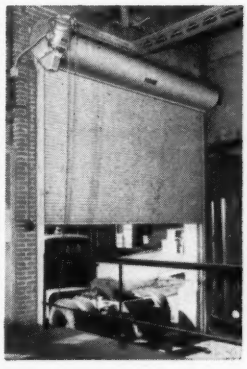
(made by the originators of the famous interlocking steel-slat door)



give you highest efficiency,

(they open straight up, coil overhead, waste no floor or wall space)

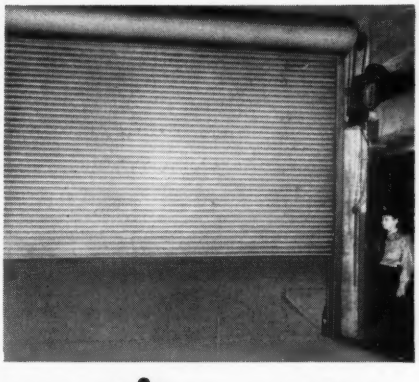




extra all-metal protection,

(their rugged steel construction resists fire, wind, theft, vandalism)

Heavy galvanizing adds 1.25 oz. of pure zinc per sq. ft. of metal by ASTM standards.



and lower operating costs

(delivering up to 20, 30, and 40 years of continuous daily service with little or no repair costs, as proved by many case records in Kinnear's files.

Kinnear Rolling Doors are built any size, for old or new buildings, with manual, chain, crank or motor operation. Write for complete information.)

KINNEAR ROLLING DOORS — SAVING WAYS in DOORWAYS

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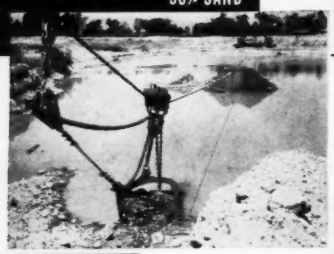
the pit: *tough...* 70% ROCK 30% SAND



the machine: Sauerman 2½-cu. yd. slackline cableway excavator

SAUERMAN FIELD REPORT:—

Helena Sand & Gravel Co., switched to this Sauerman equipment in 1946. It's been in operation since then . . . successfully performing difficult under water excavation of rock and colloidal sand where other equipment had failed.

the result:

"..a full bucket every trip"

Sauerman Slackline Cableways span water, bogs or pits . . . reach far, dig deep, lift and carry loads to hoppers or cone piles. However tough the pit, Sauerman equipment brings in a good load every trip.

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FR-216	Easy Excavating in a Tough Pit	FR-102	Digging Gravel From a River
FR-213	Cleaning Ponds Without Draining	Catalog C	Sauerman Slackline Cableways

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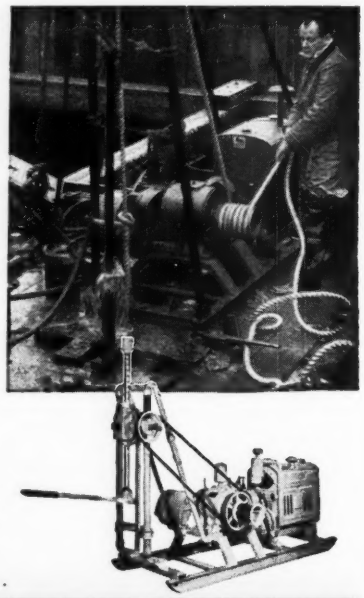
acker Portable, Power Operated Soil Sampling Rigs

Acker power operated soil sampling rigs combine into a compact, portable unit a standard power plant together with powerful hoisting winch and pump. Two models are available — Acker Model RGT for light duty and Acker RG for heavy duty service. These relatively inexpensive units are ideal for soil sampling, jetting and driving pipes or piles.



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EQUIPMENT MATERIALS and METHODS

(continued)

boost that puts it in the big tractor class and enables it to handle tougher jobs. The drawbar pull is 24,300 pounds at rated governed speed of 1450 r.p.m. The TD-18A has six forward and two reverse transmission speeds, ranging from 1.6 up to 5.5 miles per hour. Track frames have been strengthened, control levers rearranged, positive-locking brakes provided and operator comfort assured. Track frames on the new model have been

TD-18A

made 300 per cent stronger, with machined surfaces to assure permanent fit and positive track alignment. The box section track frames build up the three-point track suspension system. Track frames are kept from tilting by heavy steel arms that connect the frames with the pivot shaft by special bearing. The box sections are made up of four continuously welded individual members. Inch-thick steel plates are welded between box sections fastening them securely on top. **International Harvester Company, CE 8-121-22, 180 North Michigan Ave., Chicago 1, Ill.**

Tie Wire

CAL-TIE WIRE IS ACHIEVING WIDE ACCEPTANCE FOR TYING REINFORCING BARS and numerous other tying jobs. The versatile tie wire is packaged to assure greater safety, economy and efficiency, and is available with handy reel dispensers for use by both right and left-handed workers. The dispensers are attached with belt fittings, and leave workers' hands free for tying, carrying or holding without interference from tie wire coil. Eliminating shoulder coils also means speeded-up tying of inside forms and freedom from kinked or tangled wire. Both annealed and galvanized wire is available in gauges 14 through 20. Each coil of Cal-Tie Wire weighs a minimum of 3½ pounds and the lightweight reel dispenser weighs approximately 3 pounds. **The Colorado Fuel & Iron Corp., CE 8-122, 575 Madison Ave., New York, N. Y.**

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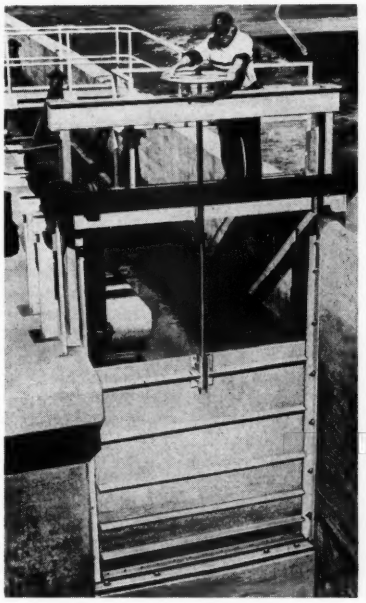
EQUIPMENT MATERIALS and METHODS

(continued)

Aluminum Slide Gate

A SLIDE GATE, MADE OF SHEET ALUMINUM REINFORCED WITH EXTRUDED ALUMINUM ANGLES, can be used where economy as well as function can be served, such as a stop-gate in by-pass channels. Not only is the gate inexpensive, but also only a simple frame is required for installation. The gate is controlled by a manually



Manually Operated Gate

operated bench-stand hoist with control stem. In normal flow, it is corrosion resistant. The manufacturer recommends use of the aluminum slide gate when odd channel sizes are present in design, full channel flow is desirable and where closure can be made under balanced conditions. **Rodney Hunt Machine Co., CE 8-000, Orange, Mass.**

Wide Panel Form

FOR LOW WALL AND GRADE BEAM CONSTRUCTION, the first of the wide panel forms has been developed. These forms are available in lengths of six and eight ft, and widths of 30, 36, 42 and 48 in. Specially designed steel struts that allow ties to pass through the face of the panels permit both the inside and outside forms to be set up simultaneously. **Symons Clamp and Manufacturing Company, CE 8-123, 4249 Diversey Avenue, Chicago, Illinois.**

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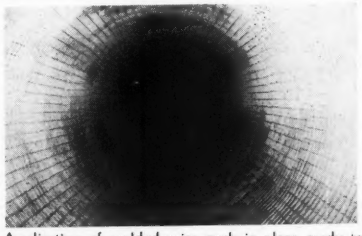
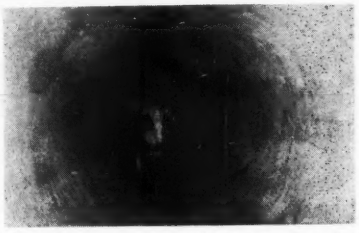
Stage of disintegration in large pipe line in New Jersey before corrective work began. All loose and disintegrated material was chipped back to sound and dependable surface.



Application of welded wire mesh in place ready to receive "Gunite" lining.



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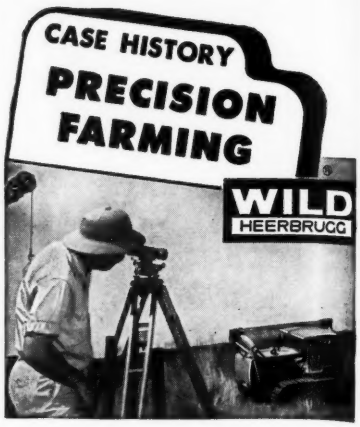
LITERATURE AVAILABLE

STEEL JOISTS—A well-illustrated booklet, complete with specifications, explains how the steel joist has developed as construction equipment. The "Clerespan" Joists are relatively lightweight steel trusses used for the direct support of floor or roof slabs or decks between walls, beams and main structural members. Supplementing the open truss steel joists, these have been standardized in depths from 18 in. to 48 in. and in spans to 96 ft. **Truscon Steel Division, Republic Steel, CE 8-124, Youngstown 1, Ohio.**

SOIL-CEMENT STABILIZATION—"The ABC's of Soil-Cement Stabilization," a 36-page brochure, strips away the mystery surrounding this modern construction method and explains how it can be used to advantage. The book presents a comprehensive, detailed story of how this material is being used as a low-cost base course in the construction of roads, streets, airports and parking lots. The brochure covers the kind of soils that can be used, how soil-cement stands up, how fast it can be laid, what size jobs it can be used on and how it is processed. For highway engineers, the advantages are presented for rebuilding existing roads and shoulders by salvaging asphaltic materials already in place and stabilizing them in cement. A series of reference charts outlines valuable tabular data on the proper use of soil-cement under varying conditions. The price is $1.00 per copy, unless requested on business letterheads. **Pettibone Wood Mfg. Co., CE 8-124, 6900 Tujunga Ave., North Hollywood, Calif.**

COPYING MACHINES—Two pamphlets describe a copying machine which prints up to one thousand $8\frac{1}{2}$ in. x 11 in. copies per hour. The machine, known as the Ozamatic, features an automatic electronic drive which controls a DC drive motor and permits it to go instantly from 0 to 30 ft per minute. Copies can be made directly from any translucent original. In the second pamphlet, the Bambino, a smaller version of the Ozamatic, is explained. **Ozalid, CE 8-124, 13 Ansco Rd., Johnson City, N. Y.**

ESTIMATING GROUT REQUIREMENTS—A handy pocket-size card estimates grout requirements of heavy equipment, machinery, anchor bolts, building columns and bridge seats. The card, designed for use by contractors, engineers and plant maintenance personnel, is based on Embeco Pre-Mixed Grout, a ready-to-use, non-shrink grouting material that requires only mixing with water. The front side of the card lists Embeco Pre-Mixed Grout yield and estimating figures for one 100 lb. bag or pail, a cu yd of flowable grout, and 100 sq ft of flowable grout 1 in. thick. **Master Builders Company, CE 8-124, 7016 Euclid Ave., Cleveland 3, Ohio.**



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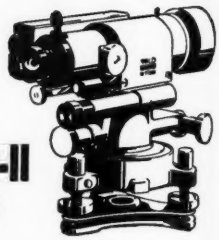

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FILMS AVAILABLE

"BRIDGING SAN FRANCISCO BAY"—This is a 16mm picture story of one of the world's greatest engineering achievements. It shows the construction of the twin suspension spans, nearly two miles long, and the cantilever span in the eight-mile San Francisco-Oakland Bay Bridge. The movie depicts the building of the deepest foundations ever undertaken, the bridging of the largest navigable body of water ever spanned. **United States Steel Corporation, CE 8-125, U. S. Steel Film Distribution Center, 525 William Penn Place, Pittsburgh 30, Pa.**

"ENGINEERED TIMBER CONSTRUCTION"—The elements of timber engineering have been brought to the screen in this 16mm sound-color film. The film features the uses of timber connectors in broadening the applications of engineering principles to wood construction. It presents a panoramic view of wood's use in versatile and economical roof trusses that provide flexibility of interior planning of homes, churches, and schools, as well as post-free space in commercial and industrial buildings. The movie shows and describes the various types of Teco connectors and how each functions in achieving more efficient use of wood in light and heavy construction. **Timber Engineering Company, CE 8-125, 1319-18th St., N. W., Washington 6, D. C.**

"COMPRESSED AIR POWER"—By using animation, the film explains graphically the compression principles of the different types of compressors, also the operating principles evolved in various means of applying compressed air power. It begins with visual demonstration of the operation of the simplest and most familiar type of air compressor, the biycle pump. This simple compressor is then visually converted to a basic power-driven compressor by replacing hand power with a conventional crank and flywheel. The operating principles of this compressor are presented through the entire compression cycle by development of a typical compressor indicator card showing theoretical adiabatic and isothermal compression and effects of cooling to dissipate heat of compression. **Compressed Air and Gas Institute, CE 8-125, 1410 Terminal Tower, Cleveland, Ohio.**

"THE ORTHOFLOW FLUID CATALYTIC CRACKER"—What is believed to be the first movie that effectively shows what happens inside a "cat" cracker has been produced. In color on 16mm film and running 15 minutes, it is done in animation. The film gives a graphic description of the various types of catalytic cracking units and how the older types were improved until we have the efficient units of today. **The M. W. Kellogg Company, CE 8-125, 225 Broadway, New York 7, N. Y.**

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For jobs not easily accessible by truck or trailer.

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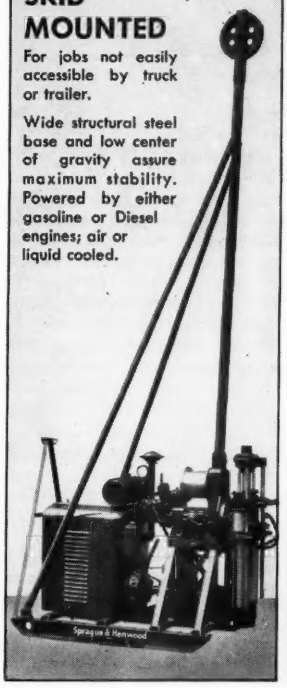

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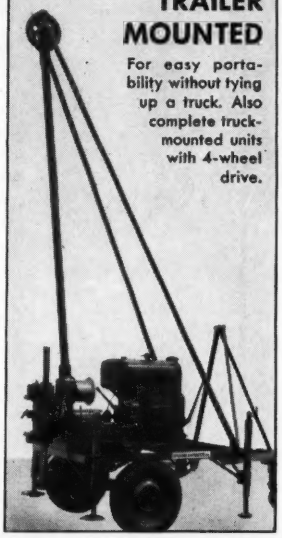

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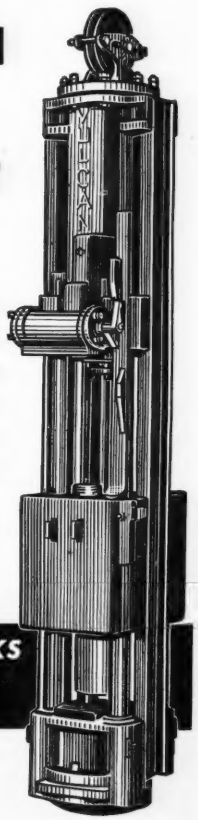

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TIDE GATES

Fig. B-68, Type M
(CIRCULAR)

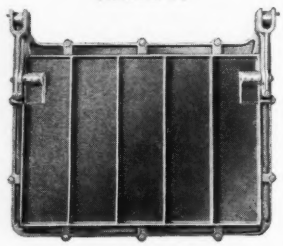

Fig. B-61, Type MM
(RECTANGULAR)

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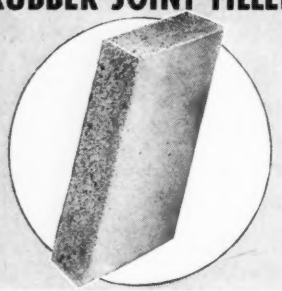

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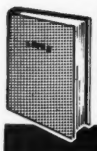
From the MANUFACTURERS

CAT ON A COLD SOUTH POLE: Rear Admiral Richard E. Byrd is taking Caterpillar crawler tractors along on his expedition to the Antarctic in November. This Expedition Deepfreeze, the Navy's Task Force 43, will begin work on three observation sites to be used by the U.S.A. in connection with the program for the 1957–58 International Geophysical Year scientific studies. Caterpillar is manufacturing the tractors for operation in temperatures of minus 65 degrees. . . **BUILDING ATOM POWER:** A combination of eight English firms enables The Nuclear Power Plant Co. Ltd. of Newcastle upon Tyne to design and construct atomic power stations in any part of the world . . . **SEPTEMBER SHOW:** American Chain & Cable's exhibit at the fall Production and Engineering Show features the advances in hardness testing and includes an automatic Rockwell machine used for quality control check. The Chicago Navy Pier is the show site, Sept. 6–16 the date . . . **GIRL ENGINEER GETS AWARD:** Minnie Griffiths, a coed at the University of Akron, receives the Robinson Engineering Award presented annually to the University's most outstanding senior in the College of Engineering. Akron's Robinson Clay Product Co. sponsors this recognition . . . **M. I. T. AWARD:** Charles C. Ladd, June M.I.T. graduate, gets the institute's Tucker-Voss Award in Building Engineering and Construction . . . **INDIA'S INDUSTRY EXPANDS:** The Indian Iron and Steel Company, Burnpur, India, orders over $1,250,000 worth of conveyor belting and machinery from Hewitt-Robins, Inc. of Stamford, Conn. for transporting iron ore . . . **FOR THE COAST GUARD:** Bludworth Marine obtains a contract to service all electronic equipment aboard U.S. Coast Guard vessels in the N.Y. area . . . The Stewart-Warner Corp. purchases the John W. Hobbs Corp. of Springfield, Ill. . . . **APPOINTMENTS:** Rear Admiral Joe W. Stryker, USN (Retired), becomes Executive Director of the Structural Clay Products Institute . . . California highway engineer Don G. Evans is district engineer for The Asphalt Institute, serving Southern California and Arizona . . . Aquatrol Ferr-X Corp. of Clifton, N.J. announces Milton L. Johnson as Vice-President of engineering . . . **ELECTIONS:** Board of Directors elects R. L. Troxell a Vice President of the American-Marietta Company . . . Charles W. Stewart, Jr., of Washington, D.C., becomes President of the Machinery and Allied Products Institute (MAPI) . . . R. V. Krikorian assumes the job of general manager of Canadian Chain Belt Ltd. at Toronto . . . **THEY RETIRE:** Bert L. Wood leaves his post as Consulting Engineer of the American Iron and Steel Institute Oct. 1. Wm. G. Kirkland succeeds him . . . Karl Keller, chairman of the board and treasurer of Keuffel & Esser Company, retires after 45 years at K & E.



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730. **Discussion of Proceedings-Papers** 393, 415, 575, 580. (SU)

731. **Surveying and Mapping for a Hydro-Electric Development, by D. J. Fraser and A. D. Hartwell.** (SU) Methods and procedures of obtaining accurate surveys and maps of the McCloud River area in northern California are described. Reconnaissance, aerial photography, ground control for aerial mapping, and other features necessary for the final contour maps are considered.

732. **An Analytical Procedure for Calculating Truss Displacements, by Alexander C. Scordelis and Cameron M. Smith.** (ST) An analytical procedure for the computation of displacements and changes in slope in a plane structure subjected to loads and displacements in its plane is presented. This method determines the displacement of several points in a trussed structure in any direction by one set of calculations.

733. **Prestressing Practices in Bridge Building, by J. C. Rundlett.** (ST) The paper summarizes a survey of growth of and trends in the use of prestressed concrete in bridge construction in the United States. It reveals that prestressing is rapidly gaining favor for medium-span structures and that there is a tendency toward pretensioned work.

734. **Influence Lines for Moment and Shear in a Continuous Beam, by Anthony Hoadley.** (ST) A method of obtaining influence lines for shear and moment at points along a continuous beam by use of the conjugate beam is described and illustrated. The method can be applied to a beam with spans of different lengths and supports that are fixed, free to rotate, or restrained.

735. **Natural Frequencies of Continuous Flexural Members, by A. S. Veletsos and N. M. Newmark.** (ST) A method is presented for computing the natural frequencies of undamped flexural vibration of continuous beams on rigid supports and rigid jointed plane frameworks without sidesway. The method is reduced to a routine system of numerical computations which, when sufficiently repeated, will give the natural frequencies of a system to any desired degree of accuracy.

736. **Impact in Railroad Bridges, by E. J. Ruble.** (ST) It has only been since the recent development of electrical strain gages that stresses in structures under high-speed trains could be reliably measured. The paper describes extensive field and laboratory investigations on railroad bridges in the United States and presents a partial summary of the findings.

737. **Morro Bay Steam Electric Plant, by J. George Thon and Gordon L. Coltrin.** (PO) Some features of this plant are (1) a condenser cooling water system utilizing a surge chamber, (2) a fuel oil supply line extending 4,000 ft into the ocean, (3) sea-water evaporators for the production of fresh water, (4) a continuous mat foundation under the main power building, (5) a reinforced-concrete stack incorporating latest concepts in seismic design, and (6) a dynamic design for turbine-generator foundations.

738. **Owens Gorge Project, by Samuel B. Morris.** (PO) This paper describes the design, construction, and the automatic and remote-controlled synchronized operation of three open-air hydroelectric plants and 12 miles of tunnels, surge chambers, and steel penstocks utilizing the fall of the Owens River.

739. **Principles of Federal Hydro-Electric Power Development, by William Whipple, Jr.** (PO) Federal hydro-electric power must be a true component of multiple-purpose basin water resource plans. Interconnection with power marketing systems requires that federal power be used primarily for peaking. Comparison with privately owned plants raises complex tax and interest problems. The paper outlines recent federal policy developments.

740. **The High-Syphon Circulating Water System for Meramec Plant, by Charles E. Buettner and Paul A. Pickel.** (PO) Condenser circulating water systems designed for moderate syphon recovery are common. This system was designed to operate with maximum theoretical syphon height. Operating experiences have demonstrated that such a system is entirely practical.

741. **Theory for the Design of Underground Pressure Conduits, by D. J. Bleifuss.** (PO) A theory for the design of underground pressure conduits is presented. The theory for designing steel liners is based on equating the deflections of steel and rock and indicates the stresses respectively carried by the steel and the rock. A method is suggested for field testing to determine the effective modulus of elasticity of the rock.

742. **Hydraulic Pressure in Concrete, by T. C. Powers.** (PO) Effects of hydraulic pressure are discussed in terms of area factor (boundary porosity) and intensity factor. The area factor is believed to depend on the nature of "ultimate particles"—the gel particles in hardened portland-cement paste. Data on gel particles indicate the possibility of a high area factor.

743. **Critical Flow Meters (Venturi Flumes), by Armando Balloffet.** (HY) The paper reviews the theory of critical flow meters and several well-known models.

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745. The Importance of Fluvial Morphology in Hydraulic Engineering, by E. W. Lane. (HY) This paper emphasizes important features of fluvial morphology such as the stages of development of a river, the base level to which many streams tend to cut down, and the tendency of stream channels to reach equilibrium. Changes of stream profile elevation are classified and illustrated.

746. Discharge Coefficients for Gates and Valves, by Charles W. Thomas. (HY) This paper suggests the use of certain control valves and gates as measuring devices. Results of tests on field installations are plotted and discussed. A comparison between prototype calibrations and model tests establishes the reliability of model-prototype correlations.

747. Minimum Pressures in Rectangular Bends, by M. B. McPherson and H. S. Strausser. (HY) Correlation of the pressure distribution for irrotational flow and actual flow for a 90° and a 180° bend of rectangular cross section is presented and augmented by pertinent data. Location and evaluation of minimum pressures are major objectives in eliminating or minimizing cavitation in the design of bends.

748. Discussion of Proceedings Papers 365, 382, 467, 565, 668. (HY)

749. The Role of the Sanitary Engineer in the Nuclear Energy Program, by Roy J. Morton. (SA) The functions of the sanitary engineer and environmental hazards in the nuclear energy program are considered. Cheaper methods must be developed for safe disposal of radioactive wastes. Present uncertainties in evaluating environmental hazards and ultimate disposal methods necessitate expanded research and more training and participation of engineers.

750. Biological Treatment of Highly Alkaline Textile Mill Waste-Sewage Mixture: Progress Report of the Industrial Waste Section of the Sanitary Engineering Research Committee of the Sanitary Engineering Division. (SA) The results of a research project on biological treatment of highly alkaline textile mill waste-sewage mixture are presented in summarized form, critically considered, and evaluated constructively with a view toward engineering application.

751. A Study of Filtration Through Uniform Sand Filters, by Joseph Tso-Ti Ling. (SA) The data given were obtained from an investigation of the clarification of water by filtration through uniform sand media; a comparison is made with the conventional graded-sand filter. Attention is devoted to the basic action of filtration within the filter bed, the effects of sand size, filter depth, and filtration rate on the removal of turbidity.

752. Discussion of Proceedings Papers 419, 454, 471, 590, 591, 592. (SA)

753. Foundation Conditions in Charleston, S. C., by L. K. Himelright. (SM) In this paper the geological and soil conditions of this area are considered. Representative soil profiles are given, and the more important soil types are described. Foundation problems, usual design procedures, and the present status of foundation investigation in the area are described, and suggestions for future investigations.

754. Rock Weathering Classification of Excavation Slopes, by J. D. Welch. (SM) The design of excavation backslopes in rock for the West Virginia Turnpike necessitated the classification of the weathering susceptibility of rock materials. Empirical investigation resulted in a laboratory method for determining this susceptibility.

755. Field Vane Shear Tests of Sensitive Cohesive Soils, by Hamilton Gray. (SM) Test results indicate that highly sensitive clays suffer a loss in strength not only during sampling but in the preparation of test specimens. Uncertainty as to the magnitude of the effect of sample disturbance emphasizes the desirability of in situ tests.

756. Settlement Analysis of Sand Drain Projects, by Edward A. Henderson. (SM) Estimated time rates of embankment settlement are compared with settlements observed on two highway projects in New Jersey where vertical sand drains were installed. Subsurface conditions and laboratory soil test data are given. Methods used to estimate the rates of settlement are outlined.

757. Seepage Forces in a Gravity Dam by Electrical Analogy, by Horace A. Johnson. (SM) This paper presents the results of an investigation of seepage forces in a concrete gravity dam and its foundation by means of the electrical analogy. The effects of methods for preventing uplift in the dam and its foundation and those of open joints and different ratios of permeability of concrete to the foundation are also considered.

758. Discussion of Proceedings Papers 400, 505, 632.(CO)

759. Discussion of Proceedings Papers 647, 516, 756.(SM)

760. Discussion of Proceedings Papers 259, 611, 612.(WW)

761. Survey of Salaries for Civil Engineering Positions, by the Committee on Salaries of the Department of Conditions of Practice. (BD) The latest in the series of salary surveys has been made for three preprofessional and nine professional grades including a geographical comparison and a listing of annual earnings of several classifications. In comparing this with the 1953 report, it is noted that salaries continue to increase in all professional grades and that proportionately greater increases in compensation have resulted for those in higher positions.

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